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Design and Implementation of Facial Recognition System for Visually Impaired using Image Processing

S.Kanaga Suba Raja, M.Vivekanandan, S.Usha Kiruthika, S.Akila R.Janani Ayshwarya

Abstract— One of the most difficult tasks faced by the visually impaired students is identification of people. The rise in the field of image processing and the development of algorithms such as the face detection algorithm, face recognition algorithm gives motivation to develop devices that can assist the visually impaired. In this research, we represent the design and implementation of a facial recognition system for the visually impaired by using image processing. The device developed consists of a programmed raspberry pi hardware. The data is fed into the device in the form of images. The images are pre-processed and then the input image captured is processed inside the raspberry pi module using KNN algorithm, The face is recognized and the name is fed into text to speech conversion module. The visually impaired student will easily recognize the person before him using the device. Experiment results show high face detection accuracy and promising face recognition accuracy in suitable conditions. The device is built in such a way to improve cognition, interaction and communication of visually impaired students in schools and colleges. This system eliminates the need of a bulk computer since it employs a handy device with high processing power and reduced costs.

Keywords: Convolutional Neural Networks (CNN), K- Nearest Neighbor (KNN).

I. INTRODUCTION

This research proposes a design and implementation of facial recognition system for visually impaired using image processing for an assistive service provided to the visually impaired child using K neighboring algorithm and machine learning. The system uses instantaneous video feed as input and produces output in audio form giving a description of the identified face if it is available in the directory. The directory contains faces of acquaintance of the person .This can include people they meet on a daily bases. The development of new technologies and concepts led to various healthcare services .These new technologies used in advancement of hospital maintenance and help in monitoring patients on a daily bases .By monitoring the patients on a daily bases we can detect any distress in patients' health and treat it on time .

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This can help in preventing the loss of one's significant life. This can also be used by the patient in assessing oneself without the help of a doctor. New technologies can help in all aspects of healthcare.

This need not only include patient monitoring, it can also be used on management side. The healthcare applications that are used in medical field include ultrasound rays, prosthetic limbs, BMI monitoring applications, food scanners, virtual reality used to study purposes. The most advanced technology so far used in medical field is robotic surgery. These technologies include concepts based on virtual reality, Internet of things, application development. These concepts are used by various researchers and students to develop new technologies for patient welfare. The blind commune uses many technologies to make their daily routine easier. There are various technologies used by the blind commune yet when the conditions are miscellaneous the need for additional knowledge becomes its con. This system can be helpful to bridge that gap. This technology can in identifying an individual which can be useful for a child in many aspects. This helps the child to socialize freely during any event. The safety of the child is increased using this system.

The difficulty in developing this system is feeding the images of the people and identifying the correct individual. The proposed system handles these obstacles by use of machine learning technology. The machine learning technology helps is arriving to the closest identification to the person in the live feed. The live feed is processed in individual frames and these frames help in distinguishing the person. The KNN based algorithm is used to identify the closest match to the person acquired from the feed by comparing the frame to the directory. This system is portable and cost effective when compared to the existing system .Thus using this system we can provide an assistive device that helps a visually impaired person and ensures their safety.

II. LITERATURE SURVEY

In the literature, the authors used different approaches to help the visually impaired people in navigation process because during their movement from one place to any other places they need safety for these reasons the existing systems had proposed many applications. They have many advantages and limitations. The most commonly used techniques are: filtering, deep learning and Convolutional Neural Networks (CNN).

Jami, William, Asif and Mary [1] all together in their system developed a prototype program which helps the college students not to smoke frequently as per their survey they found that many students especially college students

were becoming continuous smokers so they proposed this program targeting the college-aged students. The students will first answer the questions asked in the Website and delivers some text messages through cell phones for this purpose they make use of the assessment tools. Similarly in Haug and Meye [2] also developed a prototype program for continuous individual smokers to quit their smoking habit and this process also include the feedback which is added as an advantage to the Jami's program

Paul and Assan [4] put forward a project to manage the myocardial infarction accurately for better performance. The European EPI-MEDICS developed a self-care solution which is easy-to-use and portable Personal ECG monitor (PEM) for the early detection of cardiac ischemia and arrhythmia which records the ECG and compare it with a reference ECG by advanced neural network to make better decisions. It also uses decision-making methods by considering serial ECG measurements and the patient risk factors and clinical data and generates different alarms. These alarms are forwarded with the recorded ECG and the patients Personal Health Record (PHR) to the health care providers through mobile phones.

In the obstacle detection system proposed by Alberto and Yebes [9] helps the visually impaired people preventing themselves from accidents due to the obstacle behind them. First the dense disparity map is computed from the images captured by the user with the help of a stereo camera. With the help of this map potential obstacles are detected in 3D both in indoor as well as outdoor scenarios. Then a ground plan estimation algorithm is used along with the filtering techniques to allow the robust detection of the ground.The survey of the paper proposed by Tapu and Mocanu [10] exploits computer vision algorithms and deep convolutional neural networks for object detection and recognition in real time objects. An object detection technique is designed to localize objects without prior knowledge. The core of the system relies on novel object tracking method based on two KNN trained offline. Then tracking technique is validated by standard benchmarks datasets, it also minimizes the computational complexity. It is mainly designed to improve cognition and increase safety of VI people while navigating in crowded urban scenes.

Chaudhry and Chandra [11] both together estimated that 285 million people globally are visually impaired. They all mostly live in developing countries. This system is mainly designed to help visually impaired people to identify the people coming in front of them this mobile system provides increased computation capability. These people can be assisted by an additional identification method based on computer vision techniques. This application helps in both detection and recognition with good accuracy in suitable conditions.

The method proposed by Rao, Lu and Zhou [13] is attention-aware deep reinforcement learning (ADRL) method for video face recognition. This method is used to overcome the problems like misleading and confounding frames for person recognition. The Markov decision process is the process formulated instead of finding the attentions of videos and trains the attention model through deep learning framework. It takes information from both the image space and the feature space as the input. It seeks different attentions of videos for the recognition.

Goswami, Bharadwaj and Vatsa [20] proposed an idea of using Kinect for RGB-D face recognition. In their project they explained that the system they designed is mainly used to overcome the drawbacks occurred in detecting 3D images like cost and accessibility. The authors tell that for the above mentioned reasons they go for low cost sensors instead of specialized acquisition methods. The authors come up with the results that is the information like RGB-D obtained from Kinect can be used to improve the performance of face recognition compared to existing 2D and 3D approaches.

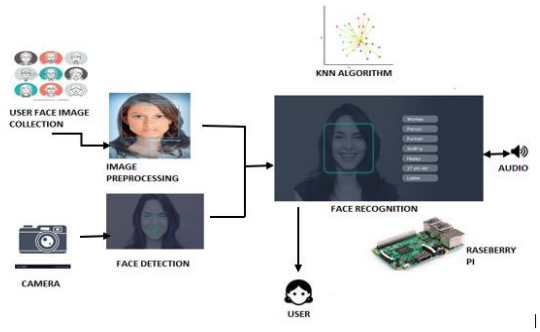
From our reference papers number [29] Jiang and Miller put forward an approach based on faster R-KNN. Normally in the last two years the object detection techniques are improving day-by-day. So the authors of this paper planned to apply a faster R-KNN which enhances the results of object detection to face detection. By using faster R-KNN the accuracy and the processing speed of the detection methods will be increased. In order to increase the accuracy and processing speed they make use of WIDER face dataset.

The authors named Yang, Ren, Zhang, Dong, and Wen [41] come up with a Neural Aggregation Network (NAN) for video face recognition. This network takes a face video or image set of a person as an input and it produces a fixed dimension feature representation for recognition. This NAN is mainly composed of two modules. First module is feature embedding module which is a deep Convolutional Neural Network (CNN). The first module is used to map each face image to feature vector. The second module is the aggregation module consists of two attention blocks. The aggregation module aggregates the feature vector obtained from the first module to form a single feature inside the convex hull. This NAN is trained well to give accurate results.

The above mentioned survey results have some limitations like cost and network coverage. The cost of installing and maintaining the network is very high comparatively. Not only the network maintenance but also the coverage of the methodology is limited. So our project overcomes all the limitations of the existing systems and increases the overall performance comparatively.

III. OVERVIEW OF PROPOSED SYSTEM

The proposed system is mainly designed to overcome the problems that a visually challenged person will face when they move in public places. This system came up with an idea of detecting the faces of people behind them. The input for this system is a face of a person who is behind the visually challenged person and output will be an audio which tells the name of the person in front of them. First the input is taken as a video stream and then the image is captured from that video which is the live feed. Then this image is taken as an input for the algorithm which converts the clear image into blurred image for the purpose of identifying the edge of the image captured. So, this image from which the edge is detected is used as an input to the KNN algorithm in order to identify the matching score which is said to be pattern recognition. Then the recognized face is sent into text to speech module where the name of the acquired face has been provided as an audio output and it is said to the user who is visually challenged. Here we make use of KNN algorithm in order to find closest probability of the face acquired.



IV. MODULES

A. EDGE DETECTION

The face images of known people for the visually impaired user are collected using different mode. The number of images collected is 4.It is done for better detection and recognition. All the images are tagged and stored in different folders. The folders are named as the user, s name. Any image without a face portion is detected and removed from the dataset.

KNN is the most widely used machine learning algorithm especially for regression and classification problem. These algorithms work on the dataset and classify new data points based on any similarity measure. Classification of data is done on the majority vote to its neighbors.

The most nearest neighbor is selected and the data is assigned to that class. In this module, the necessary libraries required to implement the KNN algorithm are imported in python. In addition, two main libraries are imported namely numpy and matplotlib.pyplot. The numpy library is used for scientific calculation and the matplotlib.pyplot library is used for plotting the graph.

The other libraries used are opencv for picture manipulation, imutils library for breaking the video into frames. The KNN trained model is used to detect the face in the video feed. The video frame with the face detected will be fed to the KNN model for face recognition.

B. PATTERN RECOGNITION

The proposed system consists of three modules in that the second module's purpose is to generate the matching scores for the images captured in the first module. This module uses the k-Nearest Neighbour (KNN) algorithm for regression and classification which is one of the simplest algorithms used in machine learning. KNN algorithm make use of a data taken from the images captured by the convolutional neural networks. Then based on the similarity the new data points are classified the more the data is given the more the accuracy will be.

The KNN algorithm is a supervised learning algorithm used in machine learning it is also said to be a lazy learning algorithms. It is also called as a competitive learning because it internally uses competition between model elements in order to make a predictive decision, whereas the lazy learners refers that until the prediction is required the algorithm does not build a model. Therefore, KNN is powerful as it calculates the distance measure between any two instances but it does not assume anything about the data.

The steps for implementing the KNN we need to handle the data, identifies the similarity, it then locates the k most similar data instances, after that it generates the response from a setoff data instances, it then summarizes the accuracy and at last the results are tied together. In python we make use of two packages named numpy libraries and matplotlib libraries.

The numpy libraries are used to do scientific calculations like matrices, multidimensional arrays etc.in our proposed system we use this library to calculate the matching score from the graph plotted. The next library used in the proposed system is a python 2D plotting library named matlibplot library. We make use of this library to plot the graphs from the data points gathered and classified. It provides the MATLAB like interface and we can use this library to generate plots, histograms, power spectra, bar charts, error charts, scatterplots etc.,

C. FACE DETECTION

The module consists of a face recognition system that uses KNN algorithm to find the closest probability to face acquired from the live feed. This system breaks the live feed into frames and each frame is applied to face detection process. The face detection process is used to identify a person by comparing the acquired face to the directory. The faces of the acquaintance stored in the directory is broken down to points and the points cumulatively provides the value to that person. By machine learning algorithm this data is trained to the system.

For the same person many images are feed to the machine as a training set by thoroughly studying each angle of the image and deriving a value for the face we can uniquely identify a particular person with a maximum probability of correctness .The data obtained is transformed into audio file that is the final output of the proposed system presented to the visually impaired person .The audial data is heed by the visually impaired person through a microphone or a speaker.

V. EXPERIMENTAL RESULTS

The system proposes an idea for helping visually impaired to communicate normally like other persons. They can easily interact with public and they can also participate in many competitions like others. Our experiment results are based on the accuracy of the detection and recognition.First the input for this system is the video stream from which the camera of the model take picture of the person in front of them. Then this system capture images from the video stream then the python code converts the normal clear image into a blur image in order to convert the image into grey scale it first needs to be converted into blur image.The purpose of blur image is to find the RGB color for the clear

image so that the image will be easily converted into grey scale.The grey scale image is identified with the help of pixel from the blur image RGB pixel value will be obtained. From the RGB pixel value, if the pixel value exceeds the specified threshold value then that part of the image will either be turned into black shade or white shade accordingly. Then the edges of the image will be identified from the grey scale image in order to identify the matching score between the images captured and the images that is already stored in the dataset.

Table Iv-1 The Accuracy Values Compared With Previous Experiments

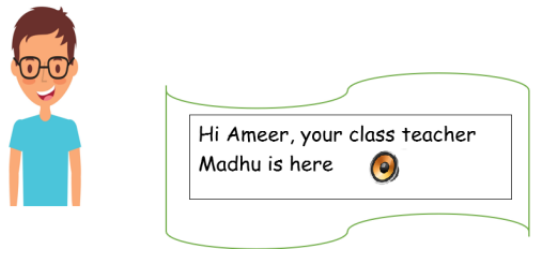


Fig Iv-1 Sample Output For The

AUDIO GENERATION

The matching score is found with the help of KNN algorithm, which is used to classify the images. Actually the KNN algorithm takes the edge image as input and then it starts the process of classification by identifying the matching scores of the images captured. If the captured image is already available in the list of images stored in the dataset then the system will inform the visually impaired user the name of the person in front of them. Thus the output of the system will be an audio which tells the user the name of the person. So that they can easily communicate with them if they are familiar to them otherwise it will inform that the person is a stranger.The parameters used in these system is Accuracy (A), Recognition Rate (%) they are calculated using following formulae:

$$AP = \frac{TP}{TP+FP} \quad (1)$$

S.NO.	METHOD	True Positive (Tp)	False Positive (Fp)	False Negative (Fn)	Recognition Rate (%)	Accuracy (%)
1	Frame based method	800	401	308	72.21	66.61
2	Weight adaptation method	983	215	125	88.71	85.25
3	Face detection algorithm	1017	142	91	91.78	92.38

$$R = \frac{TP}{TP+FN} \quad (2)$$

The accuracy of the methods used can be calculated by dividing the true positive value with the addition of the true positives and false positives. Similarly the recognition rate of the methods are also calculated by dividing true positives with the sum of the true positives and false negatives. The above evaluation uses three more parameters namely True Positive (TP), False Negative (FN), True Positive (FP).

The table IV-1 mentioned above indicates the different methodologies used for aggregation and adaptation methods and their accuracy is specified. The frame based method has the accuracy of 66.61%. Then the weight adaptation method which is used to aggregate the images detected and it has the accuracy of 85.25 percentage. Weight adaptation method is also an aggregation method which adapts to the weight of the specified similarly all the weights method and accuracy are mentioned.

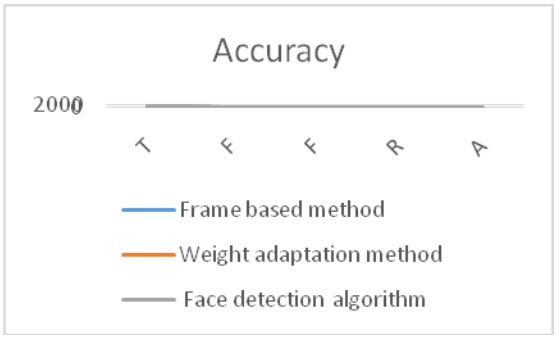


Fig IV-2 Chart That Indicates The Accuracy Of Different Methods

The fig IV-1 visualizes the accuracy of the methods which provides the information about the accuracy and recognition rate of the different methods used already in existing systems and in the proposed system.

VI. CONCLUSION

Facial recognition system concludes that the system will help the visually challenged in several purposes. It uses Raspberry Pi kit to execute this process. The Raspberry Pi kit is a small board which can be used with any operating system like Linux FreeBSD, NetBSD, RISC OS. It will improve the cognition of the visually impaired. This proposed system does not use any prior knowledge about the position of the people. The experimental evaluation is performed on a large dataset. The system will take input from the camera and gets the edges of the images. The accuracy of the face detection and recognition of the system has 92% which is comparatively perfect then the previous detection techniques.

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