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Literature Review on “RECOGNITION of STRESS USING FACE IMAGE and FACIAL LANDMARKS”

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Abstract: In this project, we propose a stress recognition algorithm using face images and face landmarks by using pi-camera for taking the input image. In the case of stress recognition using a biological signal or thermal image, which is being studied a lot, a device for acquiring the corresponding information is required. In order to remedy this short coming, we proposed an algorithm that can recognize stress from images acquired with a general camera. We also designed a deep neural network that receives facial landmarks as input to take advantage of the fact that eye, mouth, and head movements are different from normal situations when a person is stressed. Experimental results show that the proposed algorithm recognizes stress more effectively. We are using convolution neural network (CNN) for classification and training purpose, Har cascade algorithm for face detection, facial landmarks for checking eye and lips, LBPH for face detection.

Keywords: Convolution Neural Network (CNN), Local Binary Pattern Histogram (LBPH), pi-camera.

1. INTRODUCTION

Recently, as modern people suffer from extreme levels of stress, a system is being developed to recognize whether a user is under stress and to give feedback in a direction of reducing stress when under stress. In the field of stress recognition, many methods using bio-signals have been studied. However, in order to measure bio-signals, a user may feel rejection because bio-signal measuring equipment must be attached to the body. Therefore, many studies on stress recognition using thermal images have been conducted, but this also has a disadvantage in that it is difficult to recognize stress easily in daily life because it cannot be recognized without thermal imaging equipment. On the other hand, in the case of stress recognition research using a general image, most of the studies have used a relatively simple feature. In this project, we propose a method for recognizing stress by extracting high-dimensional features from face images acquired by a general camera. And in order to learn more efficient features, we use the location of facial landmarks that shows a big change when stressed.

2. LITERATURE SURVEY

[1] Face expression recognition and analysis: the state of the art

The automatic recognition of facial expressions has been an active research topic since the early nineties. There have been several advances in the past few years in terms of face detection and tracking, feature extraction mechanisms and the techniques used for expression classification. This paper surveys some of the published work since 2001 till date. The paper presents a time-line view of the advances made in this field, the applications of automatic face expression recognizers, the characteristics of an ideal system, the databases that have been used and the advances made in terms of their standardization and a detailed summary of the state of the art. The paper also discusses facial parameterization using FACS Action Units (AUs) and MPEG-4 Facial Animation Parameters (FAPs) and the recent advances in face detection, tracking and feature extraction methods. Notes have also been presented on emotions, expressions and facial features, discussion on the six prototypic expressions and the recent studies on expression classifiers.

[2] Robust facial expression recognition using local binary patterns

A novel low-computation discriminative feature space is introduced for facial expression recognition capable of robust performance over a range of image resolutions. Our approach is based on the simple local binary patterns (LBP) for representing salient micro-patterns of face images. Compared to Gabor wavelets, the LBP features can be extracted faster in a single scan through the raw image and lie in a lower dimensional space, whilst still retaining facial information efficiently. Template matching with weighted Chi square statistic and support vector machine are adopted to classify

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facial expressions. Extensive experiments on the Cohn-Kanade Database illustrate that the LBP features are effective and efficient for facial expression discrimination. Additionally, experiments on face images with different resolutions show that the LBP features are robust to low-resolution images, which is critical in real-world applications where only low-resolution video input is available.

[3] A Study of Local Binary Pattern Method for Facial Expression Detection

Face detection is a basic task for expression recognition. The reliability of face detection & face recognition approach has a major role on the performance and usability of the entire system. There are several ways to undergo face detection & recognition. We can use Image Processing Operations, various classifiers, filters or virtual machines for the former. Various strategies are being available for Facial Expression Detection. The field of facial expression detection can have various applications along with its importance & can be interacted between human being & computer. Many few options are available to identify a face in an image in accurate & efficient manner. Local Binary Pattern (LBP) based texture algorithms have gained popularity in these years. LBP is an effective approach to have facial expression recognition & is a feature-based approach.

[4] Facial Expression Recognition Based on Facial Components Detection and HOG Features

In this paper, an effective method is proposed to handle the facial expression recognition problem. The system detects the face and facial components including eyes, brows and mouths. Since facial expressions result from facial muscle movements or deformations, and Histogram of Oriented Gradients (HOG) is very sensitive to the object deformations, we apply the HOG to encode these facial components as features. A linear SVM is then trained to perform the facial expression classification. We evaluate our proposed method on the JAFFE dataset and an extended Cohn-Kanade dataset. The average classification rate on the two datasets reaches 94.3% and 88.7%, respectively. Experimental results demonstrate the competitive classification accuracy of our proposed method.

[5] Person-Independent Facial Expression Recognition Based on Compound Local Binary Pattern (CLBP)

In this paper, we present a robust facial feature descriptor constructed with the Compound Local Binary Pattern (CLBP) for person-independent facial expression recognition, which overcomes the limitations of LBP. The proposed CLBP operator combines extra P bits with the original LBP code in order to construct a robust feature descriptor that exploits both the sign and the magnitude information of the differences between the center and the neighbor gray values.

[6] A real time facial expression classification system using Local Binary Patterns

In this paper, a facial expression classification algorithm is proposed which uses Haar classifier for face detection purpose, Local Binary Patterns (LBP) histogram of different block sizes of a face image as feature vectors and classifies various facial expressions using Principal Component Analysis (PCA). The algorithm is implemented in real time for expression classification since the computational complexity of the algorithm is small. A customizable approach is proposed for facial expression analysis, since the various expressions and intensity of expressions vary from person to person. The system uses grayscale frontal face images of a person to classify six basic emotions namely happiness, sadness, disgust, fear, surprise and anger.

[7] Facial Expression Recognition Based on Local Binary Patterns and Local Fisher Discriminant Analysis

In this paper, a new method of facial expression recognition based on local binary patterns (LBP) and local Fisher discriminant analysis (LFDA) is presented. The LBP features are firstly extracted from the original facial expression images. Then LFDA is used to produce the low dimensional discriminative embedded data representations from the extracted high dimensional LBP features with striking performance improvement on facial expression recognition tasks. Finally, support vector machines (SVM) classifier is used for facial expression classification. The experimental results on the popular JAFFE facial expression database demonstrate that the presented facial expression recognition method based on LBP and LFDA obtains the best recognition accuracy of 90.7% with 11 reduced features, outperforming the other used methods such as principal component analysis (PCA), linear discriminant analysis (LDA), locality preserving projection (LPP).

[8] Real Time Facial Expression Recognition in Video using Support Vector Machines

In this paper, we present a real time approach to emotion recognition through facial expression in live video. We employ an automatic facial feature tracker to perform face localization and feature extraction. The facial feature displacements in the video stream are used as input to a Support Vector Machine classifier. We evaluate our method in terms of recognition accuracy for a variety of interaction and classification scenarios. Our person-dependent and person-independent experiments demonstrate the effectiveness of a support vector machine and feature tracking approach to fully automatic, unobtrusive expression recognition in live video.

3.GAP ANALYSIS

In [1] The major challenge that the researchers face is the non-availability of spontaneous expression data. Capturing spontaneous expressions on images and video is one of the biggest challenges ahead. As noted by Sebe et al., if the subjects become aware of the recording and data capture process, their expressions immediately loses its authenticity. To overcome this they used a hidden camera to record the subject's expressions and later asked for their consents. But

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moving ahead, researchers will need data that has subjects showing spontaneous expressions under different lighting and occlusion conditions. For such cases, the hidden camera approach may not work out. Asking subjects to wear scarves and goggles while making them watch emotion inducing videos and subsequently varying the lighting conditions is bound to make them suspicious about the recording that is taking place which in turn will immediately cause their expressions to become unnatural or semi authentic. Although building a truly authentic expression database is extremely challenging, a semi-authentic expression database can be built fairly easily.

In [2] Here it is not invariant to rotations. The size of the features increases exponentially with the number of neighbors which leads to an increase of computational complexity in terms of time and space. The structural information captured by it is limited. Only pixel difference is used, magnitude information ignored. They produce rather long histograms, which slow down the recognition speed especially on large-scale face database and under some certain circumstance, they miss the local structure as they don't consider the effect of the center pixel. The binary data produced by them are sensitive to noise.

In [3] They produce rather long histograms, which slow down the recognition speed especially on large-scale face database and under some certain circumstance, they miss the local structure as they don't consider the effect of the center pixel. The binary data produced by them are sensitive to noise. Aiming at these problems, we proposed centralized binary pattern (CBP) operator. CBP operator has several advantages. It reduces significantly the histograms' dimensionality by comparing pairs of neighbors in the operator. It considers the center pixel point's effect and gives it the largest weight, thus improving discrimination. By modifying the sign function of existing LBP operator, it decreases the white noise's influence on face images. Moreover, for the purpose of improving the robustness to small perturbation (deformation) of expressional images, we introduced image Euclidean distance (IMED) and embedded it in CBP. Experiments on two well-known facial expression databases demonstrate that the proposed method outperforms other modern approaches and show that IMED can enhance the performance of CBP in facial expression recognition.

In [4] As with any technology, there are potential drawbacks to using facial recognition, such as threats to privacy, violations of rights and personal freedoms, potential data theft and other crimes. There's also the risk of errors due to flaws in the technology. Especially, HOG shows good performance for human detection. However, it has a disadvantage that is very sensitive to image rotation. Therefore, HOG is not good choice for classification of textures or objects which can often be detected as rotated image. Massive data storage burden. The ML technology used in face detection requires powerful data storage that may not be available to all users. Detection is vulnerable. A potential breach of privacy. In SVM Choosing a “good” kernel function is not easy. Long training time for large datasets. Difficult to understand and interpret the final model, variable weights and individual impact.

In [5] In SVM choosing an appropriate Kernel function (to handle the non-linear data) is not an easy task. It could be tricky and complex. In case of using a high dimension Kernel, you might generate too many support vectors which reduce the training speed drastically. Algorithmic complexity and memory requirements of SVM are very high. You need a lot of memory since you have to store all the support vectors in the memory and this number grows abruptly with the training dataset size. One must do feature scaling of variables before applying SVM. SVM takes a long training time on large datasets. Difficult to interpret: SVM model is difficult to understand and interpret by human beings unlike Decision Trees. Moreover, for the purpose of improving the robustness to small perturbation (deformation) of expressional images, we introduced image Euclidean distance (IMED) and embedded it in CBP. Experiments on two well-known facial expression databases demonstrate that the proposed method outperforms other modern approaches and show that IMED can enhance the performance of CBP in facial expression recognition.

In [6] The downside to Haar cascades is that they tend to be prone to false-positive detections, require parameter tuning when being applied for inference/detection, and just, in general, are not as accurate as the more “modern” algorithms we have today. Principal Components are not as readable and interpretable as original features. Also, for standardization, all the categorical features are required to be converted into numerical features before PCA can be applied. PCA is affected by scale, so you need to scale the features in your data before applying PCA. LBP produce long histograms, which can slow down recognition speed, especially on large training database

In [7] Each discriminant function formed is distributed normally in each group being compared. Each discriminant function is assumed to show approximately equal variances in each group. Patterns of correlations between variables are assumed to be equivalent from one group to the next. SVM algorithm is not suitable for large data sets. SVM does not perform very well when the data set has more noise i.e., target classes are overlapping. In cases where the number of features for each data point exceeds the number of training data samples, the SVM will underperform. Principal

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Components are not as readable and interpretable as original features. Data standardization is must before PCA. We must standardize our data before implementing PCA, otherwise PCA will not be able to find the optimal Principal Components.

In [8] The main limitation of FT-CMR is that, while FT has excellent spatial resolution, temporal resolution is dependent on heart rate and is lower than the temporal resolution of 2D STE. Facial expression analysis has a major drawback – mimics could be to some extent controlled by humans and therefore the recognition results might be intentionally or unintentionally falsified. SVM algorithm is not suitable for large data sets. SVM does not perform very well when the data set has more noise i.e. target classes are overlapping. In cases where the number of features for each data point exceeds the number of training data samples, the SVM will underperform.

4. METHODOLOGY

The major problem obtained while doing this project is that creating a dataset and recognition of the facial expressions by the dataset. In the proposed algorithm, face image and facial landmark detection is performed first for stress recognition. We used a Convolution Neural Network (CNN) algorithm. In the proposed network, the face images and expression detected earlier are inputted to output stress recognition results. The results of face recognition are composed of students present in the class.

Step 1: Convolution A convolution is a joined integration of two methods that demonstrates to you how one method changes the other.

Step 2: Apply the RLU (Rectified Linear Unit)

In this step, the corrective function is used to increase nonlinearity on CNN. The data set is made up of different objects which are not linear to one another. Under this function, the grouping of information can be seen as a linear problem, although it is a non-straight problem.

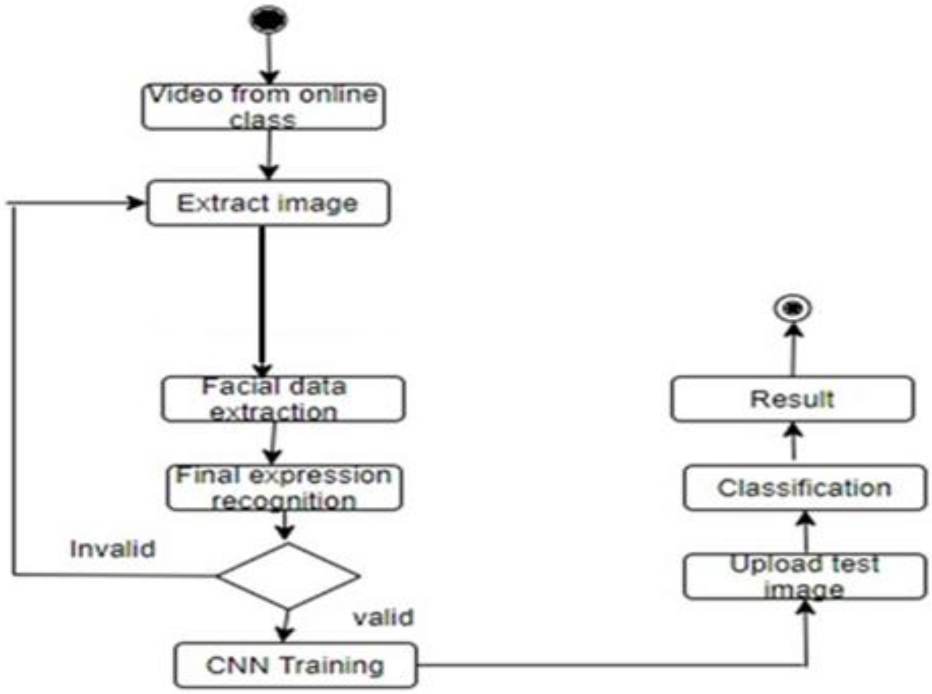
Step 3: Pooling

Spatial invariance is a term that does not influence the neural network's ability to detect its particular feats when finding an item in the data collection. Pooling helps CNN to detect swimming pools, such as max and min pools, for example.

5. SYSTEM DESIGN

5.1 Activity Diagram

The activity diagram is an UML diagram that describes the system's dynamic aspects. In fact, it is a flowchart that regulates the flow every event. The event can be described as the operation of the system. The control flow shall be taken between operations.



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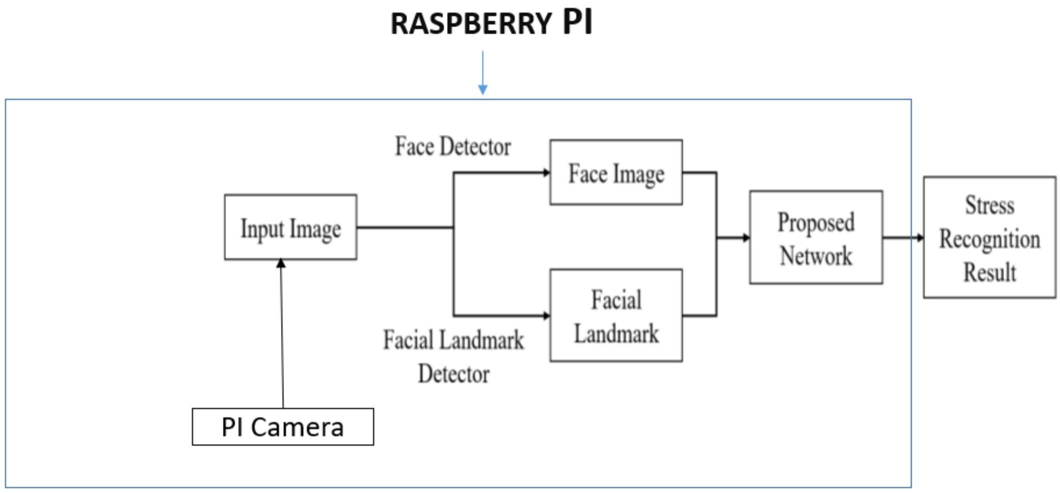
5.2 System Architecture



Input Image: The input image is taken from the pi camera which is connected to the Raspberry pi kit for the processing of the emotion recognition.
Phases in Facial Expression Recognition: The facial expression recognition system is trained using supervised learning approach in which it takes images of different facial expressions. The system includes the training and testing phase followed by image acquisition, face detection, image preprocessing, feature extraction and classification. Face detection and feature extraction are carried out from face images and then classified into six classes belonging to six basic expressions which are angry, disgust, normal, sad, surprised, happy.
Image Acquisition: Images used for facial expression recognition are static images or image sequences. Images of face can be captured using pi-camera.
Face detection: Face Detection is useful in detection of facial image. Face Detection is carried out in training dataset using Haar classifier called Voila-Jones face detector and implemented through OpenCV. Haar like features encodes the difference in average intensity in different parts of the image and consists of black and white connected rectangles in which the value of the feature is the difference of sum of pixel values in black and white regions.
Image Pre-processing: Image pre-processing includes the removal of noise and normalization against the variation of pixel position or brightness.

- Color Normalization
- Histogram Normalization

Feature Extraction: Selection of the feature vector is the most important part in a pattern classification problem. The image of face after pre-processing is then used for extracting the important features. The inherent problems related to image classification include the scale, pose.

6. RESULT and FUTURE WORK

Here different kinds of emotions can be seen, where the emotion angry, sad, disgust is more than 55% the it gets termed as stress for the following person and it shall be even stored in the XL sheet for further information. Here Twilio account is used for sending message for concerned student and principal, if the student is under stress or not, as the data shall be stored in the XL sheet and will be accessible for the principal he shall be monitoring on every student. In future by using more dataset the accuracy of the emotions can be further improved and other features can also be added.

7. CONCLUSION

This project proposes an approach for recognizing the category of facial expressions. Face Detection and Extraction of expressions from facial images is useful in many applications, such as robotics vision, video surveillance, digital cameras, security and human-computer interaction. This project's objective was to develop a facial expression recognition system implementing the computer visions and enhancing the advanced feature extraction and classification in face expression recognition. Here seven different facial expressions of students' images from different datasets have been analyzed. This project involves facial expression preprocessing of captured facial images followed by feature extraction using feature extraction using Local Binary Patterns and classification of facial expressions based on training of datasets of facial images based on convolutional neural network. This project recognizes more facial expressions based on JAFFE, COHN-KANADE face database. To measure the performance of proposed algorithm and methods and check the results accuracy, the system has been evaluated using Precision, Recall and score.

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