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An Automated Pain Assessment System Using SVM Classifier

Amirthalaksmi. T.M,
Assistant Professor, Dept of ECE, JeppiaarMaamallan Engineering College, Chennai, TN
J. Vijay,
Assistant Professor (G-II), Dept of ECE, AarupadaiVeedu Institute of Technology, Chennai, TN
N.Mageshkumar,
Assistant Professor, Vignan's Lara Institute of Technology and Science, Gundur, AP
G. Ramkumar,
Assistant Professor, Dept of ECE, JeppiaarMaamallan Engineering College, Chennai, TN
S.Agnes Shifani,
Assistant Professor, Dept of ECE, JeppiaarMaamallan Engineering College, Chennai, TN

Abstract

Facial expressions are a touchy, particular biomarker of the nearness and seriousness of pain, and computer vision and machine-learning techniques empower dependable, substantial estimation of pain-related facial expressions from video. Current pain evaluation techniques are imperfect and helpless against predisposition and under recognition of clinical pain. Automatic pain observing may help by giving a target and constant evaluation. Multiple methods have been devised which helps in identifying pain expression. In the existing system the algorithm Active apperance model (AAM) is used, which alters a full facial model of appearance and characterizes both shape variation and the texture of the model region. This approach is time consuming. This paper proposes a new approach by extrating features using viola jones and bounding box algorithm. The extracted features include different properties of painful images that can be classified by Support Vector Machine (SVM) Classifier to detect the pain. This approach provides better result compared to other state of the art

Keywords—Face detection, Face Expression, Pain Expression, AAM, SVM

Introduction

The investigation of human facial expressions has an effect in a few everyday issues, for example, workmanship, social communication, drug, security and human-computer interaction (HCI). Different uses of robotized frameworks for facial expressions recognition is in influence related research like intellectual brain science, psychiatry, and neuropsychology, where such frameworks can enhance look into quality by enhancing the unwavering quality of estimations. A Facial Expression is a noticeable show of the full of feeling state, subjective action, aim, identity and psychopathology of a person. Facial Expression pass on nonverbal communication gestures in eye to eye bury activities. Paul Ekman and Freisen have delivered FACS – Facial Action Coding System for outlining outwardly recognizable Facial developments. Utilizing the FACS, Action Parameters are described to every one of the Expressions which group the Human Emotions. There are extensive varieties of elements of Facial Expressions, some of which incorporate picture understanding, Psychological investigations, facial nerve reviewing in prescription, face image compression and engineered face animation. Above all, it can accelerate the at present dull, manual assignment of preparing information on human full of feeling conduct, strikingly utilizing the Facial Action Coding System [1][2]. Every one of these applications an automatic facial expressions classification framework is fundamental. The majority of the past work on automatic facial expression analysis has been committed to the investigation of posed facial expression and was not generally material, all things considered, circumstances [3]. In reality, unconstrained facial expressions are regularly described by inconspicuous changes of facial features while the acted facial expressions portrayed by overstated changes of facial features. Along these lines, the focal point of the research in the field towards the formation of a computerized framework equipped for distinguishing and characterizing pain in human subjects has begun. There are likewise conditions with specific individuals who experience the ill effects of incapacitates, strobe, Infants or some other comparative sort of issues where in a man can't express the intensity of pain or the kind of pain related issues faced. With such situations there emerges a need to build up a framework which is equipped for perceiving the pain expression using facial features. The constituents of the facial expression of pain have been depicted in thinks about utilizing the

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Facial Action Coding System [4]. It incorporates brow lowering, cheek raising, lid tightening, nose wrinkling, upper lip raising and eye closing [5]. Four center activities are especially predictable they are brow lowering, orbit tightening, nose wrinkling and eye closure [6]. This example of core Action Units can be separated from the examples coding for the outflow of the six basic feelings [7]. Few information recommend that, when passing judgment on others pain based on facial expression, tend to think little of the force of the sufferer pain when contrasted and their own particular reports. Experts should accordingly be more delicate to this predisposition, since it appears result in lifted dangers of under-treatment [8]. Moreover, observers are found to be less exact at recognizing pain than other negative feelings and now and then mix up pain for disgust, fear and anger. In spite of the previously mentioned discoveries and the built up significance of facial expressions in assesing pain in others, little is thought about the visual procedures embroiled recognizing pain. Illustrative techniques enable analysts to pinpoint the facial components that are engaged with the acknowledgment of the expression of pain[7]. In any case, they include making backhanded derivations about the data viably utilized by the decoder to identify feelings. Various acts of kindness which are fit for making a refinement between various human emotional states like being neutral, sadness, fear, surprise, anger, happiness, and disgust have been done light on FACS. A portion of the related calculations are found in [9-14], which may utilize facial AUs or not. At first look, it appears it can identify pain or recognize its intensity. In any case, one must notice that there are relations between some passionate states like sadness and surprise, which makes it harder to utilize mixes of AUs to detect pain. The objective of this paper build up a precise and quick calculation that can create persistent esteem that measures the pain facial expression. The dataset is gathered from the web.

Proposed Methodology

In the proposed method an image of a person either a colour image or a grey scale image is given as a input. The image is segmented using Viola Jones algorithm and bounding box algorithm. The Viola Jones algorithm will detect the face by seeing the colour variation of head and face. The Bounding box algorithm will crop the face by the pixel count and then the mouth and eye are cropped by calculating the areas of both mouth and eye. The segmented images are feature extracted using SVM classifier. The areas are trained and then stored as a database. The database used here is a painful database which is collected from web. Finally the pain of a person will be detected and displayed as an output. In existing system the calculation will be more and we need to detect the entire face this will have more disadvantages

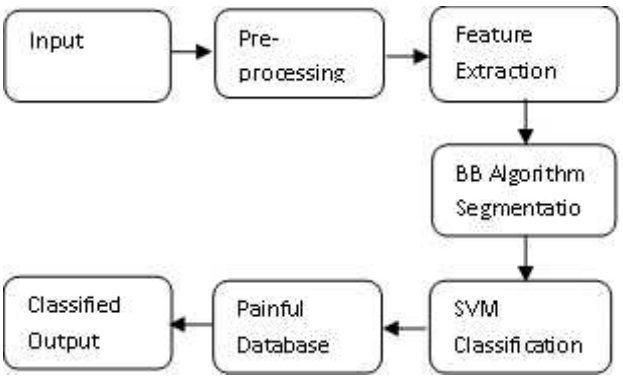

Fig 1: Block diagram of Proposed method

This strategy is basically utilized for the greater part of those individuals who face acute pain problem during sickness. Current medicinal innovation is endeavoring to help the patients in this respect. There are likewise conditions with specific individuals who experience the ill effects of deadens, strobe or some other comparable sort of issues where in a man can't express the intensity of pain or the kind of pain related problems faced. With such situations there emerges a need to build up a framework which is fit for perceiving the pain expression using facial features. This paper explores the advanced methods and techniques used to develop such a system. The viola jones segmentation process used to get the accurate result.

Preprocessing

With the end goal of face action recognition, we track the facial features heartily and proficiently. The presence of facial highlights changes because of stance, lighting, and facial expressions making the errand troublesome and complex. Automatic face registration can be accomplished by face detection and facial

landmarks identification [15]. Facial images were edited and adjusted from unique edges in view of the two eyes and mouth areas.

Feature Extraction

There are a few procedures accessible for performing face detection. In this method, we have utilized Viola and Jones face detection technique in the view of AdaBoost algorithm. AdaBoost algorithm, which is a broadly utilized machine learning calculation and is utilized as a part of conjunction with other learning calculations to enhance their execution of that calculation. Any example characterization and acknowledgment issue can be viewed as machine learning and intelligent human computer interaction ultimately. The objective of machine insight framework is to take in a characterization work from a given list of capabilities and a preparation set of positive and negative examples. The AdaBoost learning algorithm is utilized to support the order execution out of some weak learners. This unpleasant list of capabilities must be chosen and refined before being submitted to classifier learning. Feature selection is a streamlining procedure to diminish a huge arrangement of unique unpleasant highlights to a moderately littler element subset which containing just critical to enhance the grouping precision quick and successfully [16]. In order to align the faces and to obtain 2D posture standardization, the appearances are changed with the end goal that a settled separation between the two eyes and mouth is accomplished. To start with, we recognize three fiducial focuses inside the identified face district: the focal point of each eye and the mouth area. The fiducial focuses produced by Intraface are utilized for distinguishing the face points of interest. We decrease the quantity of fiducial focuses to three by averaging the distinguished historic points of each face part: left eye, right eye and mouth.

Fig 2(a) Fig 2(b) Fig 2(c)

Fig 2(a) Input image (b) Face Detection (c) Cropped Face

Fig 3(a) Fig 3(b)

Fig 3 (a) Detecting mouth region (b) Detecting eyes region

Bounding Box Algorithm

To enhance the exactness of the face location module and diminish false positives, we perform bounding box aggregation of all the identified faces of an input image. The relative places of the centroids regarding the rectangular bouncing box encasing the face region and the focal point of the eyebrow pixel organizes are utilized to decide the areas of the eyes. For face images with feeble shading contrast, exact and programmed extraction of inward and external lip limit remain a challenging task. Diverse kinds of facial hair in the mouth district convolute the lip form extraction or the lip shape itself may not be unmistakable. The mouth region is resolved from the areas of the eyes and the focal point of the mouth.

Fig 4(a) Fig 4(b)

Fig 4(a) Mouth Segmentation (b) Eyes Segmentation

SVM Classification

A Support Vector Machine is based on a supervised learning algorithm and can be employed for the classification of linear and nonlinear data. It requires a relative small number of training examples. Moreover, the SVM is insensitive to the samples' dimension. The underlying algorithm is able to discriminate between members of two classes that are usually represented as n-dimensional vectors. Therefore, SVMs are also referred to as binary classifiers. There exist also approaches for SVMs that enable the classification of multiclass problems. Most of them work by reducing multiclass problems into multiple binary classification problems. Unlike traditional classification techniques that go for limiting the Empirical Risk, SVM approaches the characterization issue as a rough execution of the Structural Risk Minimization acceptance standard, which is a decrease type of an Expected Risk minimization issue [17]. To this end, a speculation blunder of a model is negligibly limited and a choice surface is put such that the edge, which is the separation from an isolating hyperplane to the nearest positive or negative example, between various classes is amplified. SVM approximates the answer for the minimization issue of SRM through a Quadratic Programming advancement. Subsequently, a subset of training samples is picked as support vectors that decide the choice boundary hyperplane of the classifier.

Fig 5 Classification Result

Despite the fact that on a basic level the hyperplanes can just learn directly detachable datasets, in practice, nonlinearity is accomplished by applying a SVM portion that maps an info vector onto a higher dimensional element space certainly.

Implementation

We led our experiments from our own particular face database. We picked face images of 60 individuals: 25 ladies and 35 men. Every individual shows two articulations Pain and Normal. There are two pictures of every individual's appearance that were taken from two distinct sessions. In this way in all we have an aggregate of 240 facial images with 120 images for each expression. We physically edited each face image to expel the impact of the foundation. This isn't a flat out vital for our strategy if every one of the subjects were situated at generally a similar region on every image. The quantity of iterations for AdaBoost is set at 25. Both SVM and AdaBoost performed multi-class order by utilizing one-against-all divisions. For AdaBoost, we additionally tried on a comprehensive arrangement of polarities. Every single measurable consequence of our investigations depend on a 5-overlap cross approval examination where the classifiers were prepared on 80% of the information and tried on the other 20% of every 5 runs, each run holding different subsets of the information as the test set. As reflected in the outcomes, AdaBoost effectively picked the mouth and the eyes as being most enlightening and disposed of different regions as being insignificant. This is genuine on the grounds that a man's mouth and eyes appear to be unique while communicating the pain. Obviously, an appearance of a mouth district contains huge data. Likewise in this dataset, individuals shout with their eyes shut which brings about the commitment from the eye areas

Fig 6. Hardware Setup

Conclusion

Automatic pain detection is a developing zone of investigation with advantageous applications in social care. The variety in facial expression regularly gives some insight for event of pain. It gives an essential window to the individual who can't verbally portray or rate their level of pain. To get together the particular necessities, a structure has been intended for extraction of features from the face for automatic pain detection through facial expression. Here we have displayed a system for automatic pain detection by extracting the feature using Adaboost algorithm and SVM Classifier. The fundamental advantage picked up from this new feature extraction and image classification approach is the important representation of informative image regions and the lessing of computational complexity without applying any domain information. The framework consequently gains from preparing information where to search for segregating data. The reduced feature set then enables fast online classification**.**

Table 1 : Performance Measurement

AAM			SVM		
Eye	Mouth	Classi-fication	Eye	Mouth	Classi-fication
0.824	0.021	82%	0.964	0.027	89%
0.812	0.036	84%	0.978	0.041	91%
0.804	0.01	81%	0.958	0.018	88%
0.872	0.069	86%	0.952	0.077	92%
0.913	0.112	87%	0.976	0.118	91%
0.968	0.039	89%	0.984	0.045	93%
0.884	0.025	82%	0.945	0.032	89%
0.892	0.018	79%	0.936	0.021	88%
0.865	0.026	82%	0.945	0.031	90%
0.874	0.148	86%	0.936	0.153	91%
0.877	0.047	87%	0.932	0.054	92%
0.891	0.051	82%	0.926	0.056	90%
0.904	0.011	84%	0.968	0.016	91%
0.915	0.018	89%	0.967	0.023	93%
0.936	0.028	88%	0.974	0.033	92%

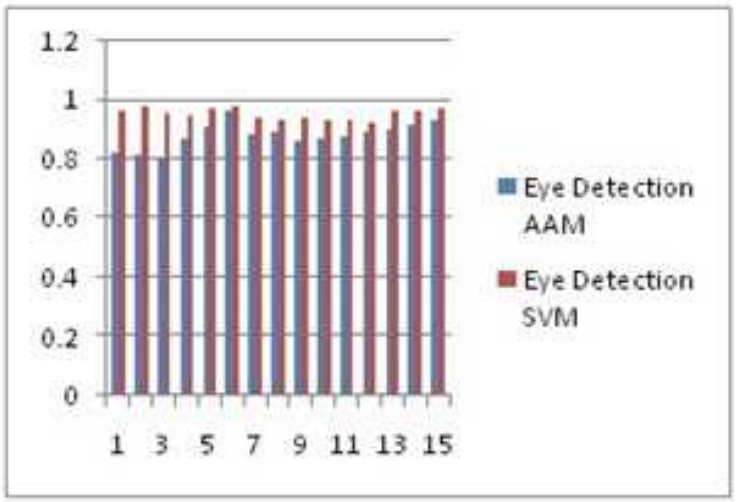

Fig 7 (a)

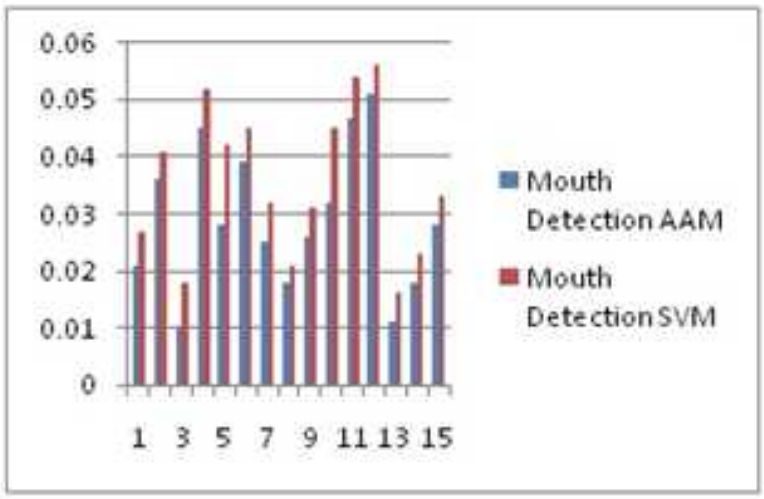

Fig 7 (b)

Fig 7 (a) & (b). Comparison chart for eye and mouth classification

References

[1] Ekman, P. and Rosenberg, E.L. (2005) "What the face reveals: basic and applied studies of spontaneous expression using the facial action coding system" 2nd edition, Oxford University Press4
[2] Ramkumar G , Logashanmugam E, (2018) "Study on impulsive assessment of chronic pain correlated expressions in facial images" Biomedical Research; 29 (16): 3181-3187, ISSN 0970-938X
[3] Fasel, B. and Luettin, J.(2003) "Automatic facial expression analysis: A survey" Pattern Recognition, 1 (30), pp. 259–275
[4] Ekman, P., Friesen, W.V. (1975)"Unmasking the Face: A Guide to Recognizing Emotions From Facial Clues" - Oxford, England: Prentice- Hall
[5] G. Ramkumar and E. Logashanmugam, (2016) "An effectual face tracking based on transformed algorithm using composite mask" IEEE International Conference on Computational Intelligence and Computing Research (ICCIC), Chennai, pp. 1- 5
[6] Prkachin, K.M. (2009) "Assessing pain by facial expression: Facial expression as nexus" Pain Res Manag 14, 53–5
[7] Simon, D., Craig, K.D., Gosselin, F., Belin, P., Rainville, P. (2008) "Recognition and discrimination of prototypical dynamic expressions of pain and emotions" Pain 135, 55–64.
[8] Kappesser, J., Williams, A.C. (2010) Pain estimation: Asking the right questions. Pain 148, 184–187
[9] Agnes Shifani, S & Revathy, S & Nanammal, V. (2019). "Dynamic facial tracking based on facial expressions using GLCM algorithm", Dusunen Adam. 10. 1308-1312
[10] Y. Li, S. Wang, Y. Zhao and Q. Ji (2013) "Simultaneous facial feature tracking and facial expression recognition", IEEE Transactions on Image Processing , Volume 22, Issue 7, pp 2559 – 2573
[11] Y. Rahulamathavan, R.-W.Phan, J. A. Chambers and D. J. Parish, (2013) "Facial expression recognition in the encrypted domain based on Local Fisher Discriminant Analysis", IEEE Transactions on Affective Computing, Volume 4, Issue 1, pp 83 – 92
[12] Y. Piparsaniyan, V.K. Sharma and K.K. Mahapatra, (2014) "Robust facial expression recognition using Gabor feature and Bayesian discriminating classifier", International Conference on Communications and Signal Processing (ICCSP), pp 538 – 541
[13] G. Ramkumar, E. Logashanmugam, (2019). "Multimodal verge for scale and pose variant real time face tracking and recognition" Indonesian Journal of Electrical Engineering and Computer Science, ijeecs.v13.i2.pp665-670.
[14] E. Sariyanidi, H. Gunes and A. Cavallaro.(2015) "Automatic analysis of facial affect: A survey of registration, representation, and recognition", IEEE Transactions on Pattern Analysis and Machine Intelligence, Volume 37, Issue 6, pp.1113 – 1133.

[15] Xiong, X., De la Torre, F. (2013) "Supervised descent method and its applications to face alignment" IEEE Conference on Computer Vision and Pattern Recognition
[16] Mr. Kaustubh Patil, Promod Kakade. (2014). Self-Sustained Debacle Repression Using Zig-Bee Communication. International Journal of New Practices in Management and Engineering, 3(04), 05 - 10.
[17] Ruihu Wang (2012) "AdaBoost for Feature Selection, Classification and Its Relation with SVM, A Review" Physics Procedia, Elsevier
[18] Ramkumar, G. & Logashanmugam, E.. (2018). Hybrid framework for detection of human face based on haar-like feature. International Journal of Engineering and Technology(UAE). 7. 1786-1790. 10.14419/ijet.v7i3.16227.

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