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ORIGINAL ARTICLE

RECOGNITION OF EYE MOVEMENTS USING FACIAL ACTION CODING SYSTEM

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Abstract:

Face recognition is an important research problem spanning numerous fields and disciplines. Face recognition having numerous practical applications such as bankcard identification, access control, Mug shots searching, security monitoring, and surveillance system, is a fundamental human behavior that is essential for effective communications and interactions among people. The human face is involved in a large variety of different activities. It houses the apparatus for speech production as well as the majority of our sensors (eyes, nose, mouth). Besides these biological functions, the human face provides a number of social signals essential for our public life. This paper introduces recognition of eye movements. The ability to recognize facial signals is essential of human facial expression is a challenging problem with many applications. In this paper we use eye movement recognition technique using Facial Action Coding System (FACS) is the most widely used and versatile method for measuring and describing facial behaviors. A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source.

KEYWORDS:

FACS, Eye moment.

INTRODUCTION:

The studies on human face recognition were expected to be a reference on machine recognition of faces, research on machine recognition of faces has developed independent of studies on human face recognition. During 1970's, typical pattern classification techniques, which use measurements between features in faces or face profiles, were used [1]. During the 1980's, work on face recognition remained nearly stable. Since the early 1990's, research interest on machine recognition of faces has grown tremendously. A formal method of classifying faces was first proposed in [2]. The author proposed collecting facial profiles as curves, finding their norm, and then classifying other profiles by their deviations from the norm. This classification is multi-modal, i.e. resulting in a vector of independent measures that could be compared with other vectors in a database. Progress has advanced to the point that face recognition systems are being demonstrated in real-world settings [3]. Face Recognition has been an interesting issue for both neuroscientists and computer engineers dealing with artificial intelligence (AI). A healthy human can detect a face easily and identify that face, whereas for a computer to recognize faces, the face area should be detected and recognition comes next. Hence, for a computer to recognize faces the photographs should be taken in a controlled environment; a uniform background and identical poses makes the problem easy to solve. These face images are called mug shots [4]. From these mug shots, canonical face images can be manually or automatically produced by some preprocessing techniques like cropping, rotating, histogram equalization and masking. The history of studies on human face perception and machine recognition of faces. Template Matching: Brunelli and Poggio [5] suggest that the optimal strategy for face recognition is holistic and corresponds to template matching. The Eigenface Method of Turk and Pentland [6] is one of the main methods applied in the literature which is based on the Karhunen- Loeve expansion. Their study is motivated by the earlier work of Sirowich and Kirby [7], [8]. It is based on the application of Principal Component Analysis to the human faces. It treats the face images as 2-D data, and classifies the face images by projecting them to the eigenface space which is composed of eigenvectors obtained by the variance of the face images. Eigenface recognition derives its name from the German prefix eigen, meaning own or individual. The Eigenface method of facial recognition is considered the first working facial recognition technology [9]. When the method was first proposed by Turk and Pentland [6], they worked on the image as a whole. Also, they used Nearest Mean classifier two classify the face images. Etemad and Chellappa [10] proposed a method on appliance of Linear/Fisher Discriminated Analysis for the face recognition process. Subspace LDA: An alternative method which combines PCA and LDA is studied [11-14]. Bobis et al. [15] studied on a feature based face recognition system. They suggested that a face can be recognized by extracting the relative position and other parameters of distinctive features such as eyes, mouth, nose and chin.

METHODOLOGY:

Facial feature extraction consists in localizing the most characteristic face components (eyes,nose, mouth, etc.) within images that depict human faces. In this paper we develop new, more accurate representations for facial expression by building a Photo database of facial expressions and then probabilistically characterizing the facial muscle activation associated with each expression using a detailed physical model of the skin and muscles. For Study of eye moment, Facial Action coding system is used. In this FACS method for facial feature extraction that we use for the initialization of our face recognition technique.

SCORING PROCEDURE

1. Notation

Always list the AUs in numerical order to facilitate communication. Alphabetical letters (i, ii) that refer to specific images or to persons (w, j) are not used when scoring. When intensity is scored, add the letter A, B, C, D, or E immediately after the AU number; complying with the intensity guidelines for each AU. Unilaterality is noted by indicating the side of the face where the appearance change occurred. This notation is placed in front of the AU number. Use “L” for the left and “R” for the right side of the person's face. Remember that this reference is not to your left or right side as you look at the picture, but to that of the person in the image. Unilaterality is not scored if there is even a trace of the AU on the other side of the face. Involvement of only one lip, rather than both lips, is noted by indicating whether the AU was present only in the top or bottom lip. This notation can be used only with AUs 8, 18, 22, 23, and 28. As with unilaterality, this notation is placed in front of the AU number. Use “T” for the top and “B” for the bottom lip. Single lip involvement is not scored if there is even a trace of the AU on the other lip. Recall you cannot score an action as unilateral and present in only one lip. You must choose between these two, which best describes the action, unilaterality or Top vs. Bottom. Action Units that are scored for intensity of action, are not scored separately for left and right side simply because the AU is more evident on one side than the other. The intensity rating is made for the stronger movement on either side of the face. Often you may find that evidence for an AU appears on one side of the face, but not the other. As long as there is some evidence on the other side, any trace of any appearance change for that AU, score the action as bilateral. It is only when there is no trace of the Action Unit, or a different appearance change on the other side, that a unilateral score is used.

2. Score Sheet

Scoring for the Lower Face, Upper Face, and Head and Eye positions is entered on the front side of the Score Sheet. The listing of AUs for the Omission Check, Scoring Step II, is on the other side where each AU is listed by its number and name. Put your name, date and the time of scoring on the bottom of the front side of the Score Sheet. Identify the image you are scoring in the space provided for “stimulus.” When you cannot score a facial area because it is not visible, use a score of 70 if the brow is not visible, 71 if the eyes are not visible, 72 if the lower face is not visible, and 73 if the entire face is not visible. Do not score an area of the face as “not visible” if it is possible to score any AU that affects this area. For example, if the subject places a hand on the brow, but wrinkles in the center of the upper part of the brow allow you to score AU 1, you do not score the brow as not visible (70), even though you may be in doubt as to whether AU 4 is also present. A score of 73 is used bilaterally, only when the head is turned so much that the back of the head faces the coder, the subject moves his head completely from your line of view, or an obstacle covers the face completely. You may, however, use any of the "not visible" scores as occurring only on the left or the right side of the face. This situation occurs most often when the head is turned far to the side, and is scored L73 or R73. Usually the head turn would have to be extreme so that no part of the area beyond the midline of the face is visible, as many AUs can be inferred from seeing only a small portion of each facial area. Scores 70, 71 and 72 may also be used unilaterally. To help you remember which AUs cannot be scored with each of the "not visible" scores, scores 70 and 71 are located with the Action Units that can affect the brow and eye areas. Score 72 is located with the Lower Face as it cannot be scored simultaneously with any of the Lower Face scores. Score 73 has been placed with the final full-face score. The minimum number of Action Units that can be scored for a facial event is one. If there is some movement during the event you are scoring that is not possible to score as any AU or AD2, record the event as an "Unscorable" action, 74. Use 74 for unscorable movements only when there is no other scorable AU or AD on the upper and lower face. If unscorable movement is observed on the face during a Head/Eye position change, 74 is scored with the Head/Eye position scores. If there is no detectable action of any kind, the face is scored "Neutral:" (AU 0). Neutral is scored only once for a facial event and cannot be scored with any other AU or AD. If all that is observed during a movement is a shift in the Head and/or Eye position, then NEUTRAL (0) must be scored with the position scores. Unlike the "Not Visible" scores (70, 71, 72 or 73), 0 Neutral or 74 Unscorable are not scored for the separate areas of the face, nor is either scored unilaterally. Scoring proceeds in the following order:

1. Lower Face is scored before the Upper Face, since if certain Lower Face AUs are scored, they change the criteria for certain Upper Face AUs. If any of the Miscellaneous Actions are to be scored, they are scored with the Lower Face.
2. Head and Eye position is scored next, if it is to be scored at all. If Head and Eye position is not scored, the Head/Eye check must be made to verify whether the view of the subject affects the scoring of the other AUs.
3. Upper Face scoring is done last.
4. The score for the total face is the combination of scores, possibly rearranged, for the Upper Face, Lower Face, and Head and Eye position scores.

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EXPERIMENTAL ANALYSIS OF EYE MOMENT USING FACS

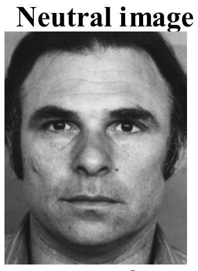
Images which are related to the eye movements and study are performed on AU which can occur in the images. AU studied manually using score sheet and then checked by FACS score checker. We have considered six types of Eye movements which are present in following images like Neutral image, Eye Closure, Eyes left, Eyes right, Eyes up, Eyes down. The face is not showing any action, often called a neutral face. The face is not actually at rest because the eyes are open, the jaw is closed, etc., but no AU can be scored. This neutral face is the baseline for scoring AUs in the example images of this person, and similar states of "neutral" faces are used most often as baselines in actual scoring situations, although other baselines can also be used.

Image 43i: The upper eyelid is relaxed and drooping down slightly, sufficient to score 43B. Note that the shape of the lower eyelid is little changed from neutral and there is no additional wrinkling. Be sure to compare the appearance of relaxing the upper eyelid in 43 to that resulting from the tensing of the orbicular muscle that is apparent in the 6 and 7 items above.

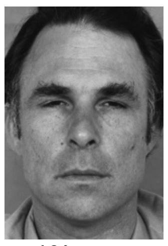
Image 43ii: This appearance results from relaxing the upper eyelid, and the eyelids are almost together (closed), but the gap between them can still be seen, especially in the medial parts and around the lacrimal gland. This evidence is sufficient to score 43D. Compare this appearance to the next item, which shows the eyelids closed.

Image 43iii: The eyes are closed in 43E. Notice that when the eyes are closed, you see the upper eyelashes laying on the skin of the lower lid and little or nothing of the lower eyelashes. No sclera or mucosa can be seen. No evidence of any other action is present in this example.

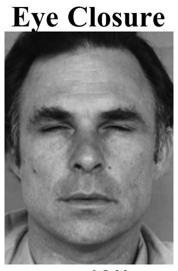
Neutral image **Eye Closure**



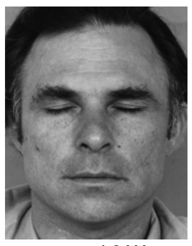
0



43i



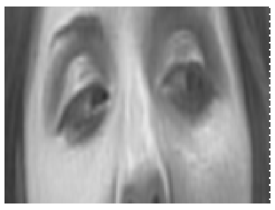
43ii



43iii

In scoring Eyes Left and right, We can distinguish marked Eye Turn 62B from severe Eye Turn 62C. Anything beyond 62C is scored as 62C or 62D until you reach the point where there is no sclera visible on one side of the iris, which is scored 62E. In scoring Eyes Up, you can score 63 if: you can see sclera below the iris, and in the neutral face you cannot. you can see all of the bottom of the iris, and in the neutral face you cannot. You cannot see the top portion of the iris, and in the neutral face you can. In scoring Eyes Down you can score 64 if: you can no longer see all of the bottom of the iris, but in the neutral face you can, and this is not due to AU 6, 7, 9, 10, 12, or 13. You can no longer see the entire pupil but in the neutral face you can.

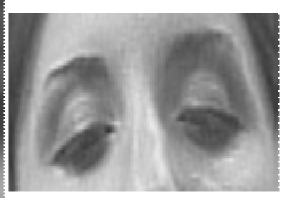
Eyes Left **Right eyes** **Eyes up** **Eyes down**



61B

62C

63



64

Facial Action Coding System: Score Sheet Designed by Paul Ekman and Wallace V.Friesen
Score sheet # 1 Image 1

Lower Face
I. Initial Scoring:
II. Omission Check:
III. Reorganized Scoring:
IV. Reference Check:
AUs in Numerical Order:
Alternative AUs: Reference Check:
Results for Step IV:
V. Revised Scoring:
Head/Eye Position:
Upper Face
I. Initial Scoring: (4 + 6 ref) + 7 + 43

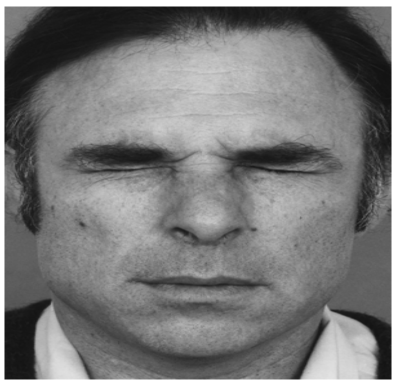


Image 1

II. Omission Check :(4 + 6 ref)
III. Reorganized scoring :(6 or 4+6 ref) + 7 + 43
IV. Reference Check: (especially: 4 with 9; 6 with 9, 10, 12, & 13; 7 with 6, 12, & 13)
AUs in Numerical Order: 6 + 7 + 43
Alternative AUs: None Reference Check:
Results for Step IV:

V. Revised Scoring: 6B + 7E + 43E
Final Scoring Upper Face: Final Scoring Lower Face: Final Head/Eye Positions:
6B + 7E + 43E
Final Full Face Score:
(Score 73 if Entire Head/Face is out of view)
Coder's Name: Date: Time:
Stimulus: Image # 1 Segment: Item:
Location: Beginning End

CONCLUSION:

•Focus on developing real time and non-intrusive system for spontaneous facial activity understanding system
• Combine computer vision with graphical models for robust and consistent visual understanding and interpretation
•Apply to different applications human computer interaction (e.g. emotion recognition), transportation, security, medical diagnosis, learning, games, polygraph, entertainment, etc.

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