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Elicitation of Apt Human Emotions based on Discrete Wavelet Transform in E-Learning Environment

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Abstract- This paper is going to address one of the important challenges faced by e-learning environment that is simulating a real-time class room environment. The success of the class room is mainly because of the special bond the tutor and the student share among themselves in a class room but this affective aspect completely get missed in e-learning environment. Most of the research which is been going on this field have concentrated only on student emotional aspect to some extent leaving completely the emotional aspect of the Teacher. When the most of the educational institution is concentrating on the cognitive aspects of the pedagogy, this paper is strongly advocating on the affective aspect of the pedagogy – which is the need of the hour. This paper deals with how the emotion captured for both the teacher and student by means of energy coefficients calculated by Discrete Wavelet Transform(DWT) method to be used effectively and efficiently in the e-learning platform.

Keyword: Facial Expression,Discrete Wavelet Transform, Human-Emotion and Classification, Affective Learning,Krawthwohl Taxonomy

1. INTRODUCTION

According to Gail Godwin 'Good Teaching is one-fourth preparation; three fourth theatre', The above quote stress the fact that how Teaching with all the motion of body and facial expression is the essential tool for student learning capability.The affective domain (from the Latin affectus, meaning "feelings") includes a host of constructs, such as attitudes, values, beliefs, opinions, interests, and motivation. The affective domain describes learning objectives which emphasize a feeling tone, an emotion, or a degree of acceptance or rejection. Affective objectives vary from simple attention to selected phenomena to complex but internally consistent qualities of character and conscience. The affective domain can significantly enhance, inhibit or even prevent student learning. The affective domain includes factors such as student motivation, attitudes, perceptions and values. Teachers can increase their effectiveness by considering the affective domain in planning courses, delivering lectures and activities, and assessing student learning.

The motion or positions of the muscles in the skin of a human face convey the emotional state of the individual to observers. These emotional states are a form of nonverbal communication. The recognition of emotional state of a human face has attracted increasing notice in pattern recognition, human-computer interaction and computer vision.

2. RELATED WORK

A method for automatic recognition of facial expressions from face images by providing Wavelet Transform features to a bank of five parallel neural networks is presented in [1]. Each Neural Network (NN) is trained to recognize a particular facial expression, so that it is most sensitive to that expression. A new approach to facial expression recognition based on Stochastic Neighbor Embedding (SNE) is presented in [2]. SNE is used to reduce the high dimensional data of facial expression images into a relatively low dimension data and Support Vector Machine (SVM) is used for the expression classification. A new approach for the 3D human facial expressions analysis is presented in paper [3]. The methodology is based on 2Dand 3D wavelet transforms, which are used to estimate multi-scale features from real a face acquired by a 3D scanner. The different feature extraction techniques with advantage and disadvantage and find the recognition rate by using JAFFE databases is studied in [4]. The Adaboost classifier is used to classify the facial expression and from the JAFFE databases 60% data are used for the training and 40% data are used for the testing purpose.

Various feature representation and expression classification schemes to recognize seven different facial expressions, such as happy, neutral, angry, disgust, sad, fear and surprise, in the JAFFE database is investigated in [5]. A facial expression recognition system based on Gabor feature using a novel Local Gabor filter bank is proposed in [6]. A two-stage classifier for the elastic bunch graph matching based recognition of facial expressions is proposed in [7].

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The distinctive similarity between image patterns are obtained by applying optimal weights to responses from different Gabor kernels and those from different fiducial points.

An algorithm based on Gabor filter and SVM is proposed for facial expression recognition in [8]. First, the features of facial expression emotion are represented by Gabor filter. Then the features are used to train the SVM classifier. Finally, the facial expression is classified by the SVM. A new method of facial expression recognition based on local binary patterns (LBP) and Local Fisher Discriminant Analysis (LFDA) is presented in [9]. 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.

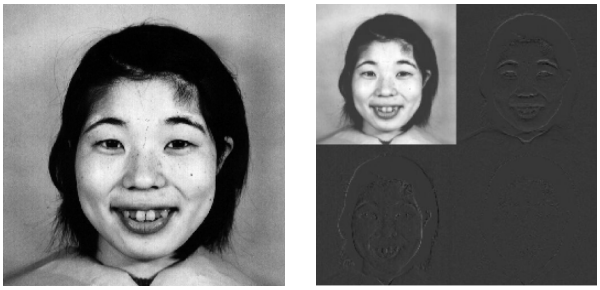
The performance of different feature extraction methods for facial expression recognition based on the higher-order local auto correlation (HLAC) coefficients and Gabor wavelet is investigated in [10]. An experiment on feature-based facial expression recognition within an architecture based on a two-layer perceptron is reported in [11]. The geometric positions of a set of fiducial points on a face, and a set of multi-scale and multi-orientation Gabor wavelet coefficients' at these points are used as features. A method of facial expression recognition based on Eigen spaces is presented in [12].

3. PROPOSED SYSTEM

3.1 DISCRETE WAVELET TRANSFORM

Nowadays, wavelets have been used frequently in image processing and used for feature extraction, denoising, compression, face recognition, and image super-resolution. The decomposition of images into different frequency ranges permits the isolation of the frequency components into different sub-bands. This process results in isolating small changes in an image mainly in high frequency sub-band images.

The 2- D wavelet decomposition of an image is performed by applying 1-D DWT along the rows and then columns. At first, 1-D DWT is applied along the rows of the input image. This is called row-wise decomposition. Then, 1-D DWT is applied again along the columns of the resultant image. This is called column-wise decomposition. This operation results in four decomposed sub-band images referred to as low–low (LL), low–high (LH), high–low (HL), and high–high (HH). For multi resolution analysis, the LL band of previous level is again decomposed by DWT. Figure 1 (a) shows the original image and Figure 1 (b) shows the wavelet transformed image at level 1



(a) (b)

Figure 1: (a) Sample image from JAFFE database (b) 2-D Wavelet transformed image at level 1

3.2 K-NEAREST NEIGHBOR CLASSIFIER

The K-nearest neighbor algorithm (K-NN) is a method for classifying objects based on closest training examples in the feature space. K-NN is a type of instance-based learning where the function is only approximated locally and all computation is deferred until classification. In K-NN, an object is classified by a majority vote of its neighbors, with the object being assigned to the class most common amongst its k nearest neighbors (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of its nearest neighbor. The neighbors are taken from a set of objects for which the correct classification is known. This can be thought of as the training set for the algorithm, though no explicit training step is required. The distance measure used in the proposed emotion recognition system is Euclidean distance.

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Let us consider $a = (x_1, y_1)$ and $b = (x_2, y_2)$ are two points. The Euclidean distance between these two points is given by

If the points have n-dimensions such as $a = (x_1, x_2, x_3, \ldots x_n)$ and $b = (y_1, y_2, y_3, \ldots y_n)$ then the generalized Euclidean distance formula between these points is

The JAFFE database [13] is used to evaluate the performance of the proposed system. The database contains 213 images of 7 facial expressions. The facial expressions in this database are happiness, sadness, surprise, anger, disgust, fear and neutral. The images in the database are grayscale images of size 256x256 in the tiff format. The heads of the subjects in the images are in frontal pose. The eyes are roughly at the same position with a distance of 60 pixels in the final images. The proposed system is implemented in MATLAB version 7.10. Many computer simulations and experiments with JAFFE images are performed.

4. EXPERIMENTAL RESULT

All the images in the JAFFE database are considered for the emotion recognition test. Among the 213 images 140 images from 7 facial expressions are used for training the classifier and remaining 73 images are used for testing the classifier. The average classification rate obtained by the proposed emotion recognition system is shown in Table 1[14].

LEVEL OF DECOMPOSITION	AVERAGE RECOGNITION RATE (%)
	DWT
1	73.58
2	75.00
3	73.55
4	77.28
5	80.08
6	84.02
7	84.72

Table 1 Average Classification rate of the proposed emotion recognition system

Using the DWT method and K-nearest neighbor classification we can get the maximum extraction of human emotions at the seventh level of decomposition. By applying this new DWT findings in Krawthwohl Taxonomy[15], the Tutor can clearly analyze whether the student as grasped the subject being taught by analyzing his facial expression when he assimilate knowledge into wisdom.

4.1 APPLICATION OF DWT TECHNOLOGY ON KRAWTHWOHL TAXONOMY FOR EFFECTIVE E-LEARNING

Current educational philosophy (Figure 1), in general, tends to focus on the means to provide 'information' to the masses. This leads to standardized tests that draw out this 'information' and those who can extract it are judged to be 'educated' or worse 'intelligent'—but this is not intelligence. This approach/belief merely develops a generation of people who will make great *game-show-contestants.* It does little to provide future adult citizens with needed capacities. It does develop rule-based learners in an era that yearns for value-based reasoners.

To understand the need for a novel model (see Figure 2) it is necessary to explore the current model. The current model, as shown in Figure 1, begin with 'data.' 'Data' (in Figures 1 and in Figure 2) is an accumulation of answers to as yet unasked questions; 'information' is the answer to an asked question. 'Information' is like the pieces to an unassembled jigsaw puzzle and 'knowledge' is the assembled jigsaw puzzle. In the normal education flow of the present day, a student is given 'data' (the answer to an unasked question). Then the 'data' becomes 'information' when a question is asked. And again,' Information' is like the pieces of an unassembled Jigsaw Puzzle. 'Knowledge' is like an assembled jigsaw puzzle. The Question- Answer pairs are organized into a structure, in the logical order in which new questions arise. But the novel model (Figure 2) that is offered here goes beyond the current day model shown in Figure 1.

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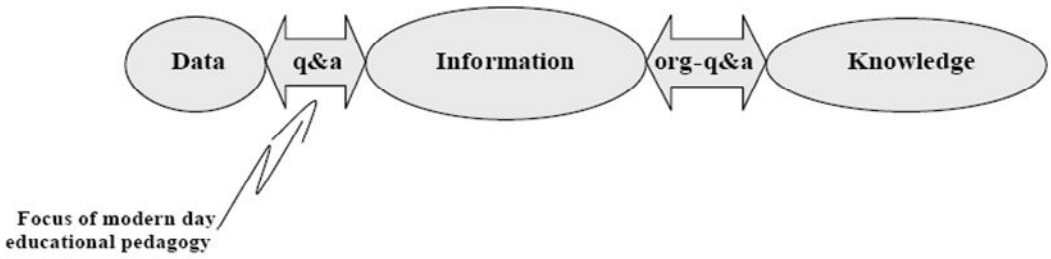

Figure 1 -- Model to Rule-based Thinking

The foci of attention is drawn away from a focus on providing 'data' and developing the 'data' into 'information' to focusing on the development of 'knowledge' (through some sort of 'insight') and the development of 'wisdom' in the presence of a Values System (or this may be characterized as the application of 'knowledge') and through 'deployment' of this wisdom in day to day learning and become ' expert'. The novel model which is proposed is mainly dwelling on the three higher aspects of Kratwohl taxonomy (Value(insight), Conceptualize and Internalize(deployment)). The teacher by inculcating these three higher aspects(affective aspects) in student can metamorphose the average student to an expert level. Based on this model we are going to discuss the new model of learning ---- How a learner's affective state could judiciously be combined with cognitive state to make an effective learning.

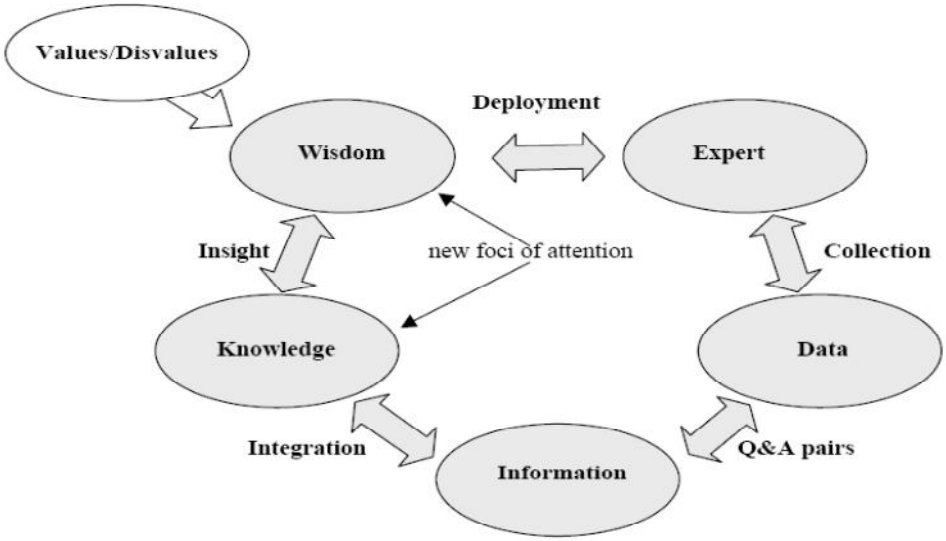

Figure 2 -- Novel Model of Educational Pedagogy

In an attempt to install/build/reengineer the current state of educational pedagogy, the new breed of educators should first look to expert teachers who are very adept at recognizing the emotional state of learners and based upon their observation, take some action that positively scaffolds learning. But what do these expert teachers *see* and how do they decide upon a course of action?

Skilled humans can assess emotional signals with varying degrees of precision; we believe that accurately identifying a learner's emotional/cognitive state is a critical indicator that will determine how to assist the learner in achieving an understanding of the efficiency and pleasure of the learning process. It is necessary for us to rethink our perspective of what is happening during learning and based upon our hypothesis, reengineer accordingly. This supposition is based upon many preliminary studies, which is conducted over the many education institution, which suggest that a human observer can assess the affective emotional state of a student with reasonable reliability based on observation of facial expressions, gross body language, and the content and tone of speech.

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If the human observer is also acting in the role of coach or mentor, these assessments can be confirmed or refined by direct conversation (e.g. simply asking the student if they are confused or frustrated, before offering to provide coaching or hints). Moreover, successful learning (e.g. solving a difficult puzzle) is frequently marked by an unmistakable elation. In some cases, the "Aha!" moment is so dramatic, it verges on the epiphanic. One of the great joys for an educator is to bring a student to such a moment of epiphany in e-learning environment.

5. CONCLUSION AND FUTUREWORK

The institution which are offering the courses through e-learning, from the beginning stressing on the cognitive aspects of the courses alone, leaving the important domain, affective aspect, to the detriment of the student learning. In a real time environment it is neither the infrastructure nor the technical content of course which makes the learning enjoyable but emotional relationship that exist between the tutor and the student which makes the learning easy and enjoyable. The same is true in case of e-learning environment too, this is what this paper stresses more effectively. This paper proposes a complete paradigm shift towards the e-learning environment, which will instead of pushing the students, will pull the students towards effective learning. Hence this paper calls upon the architects and designers of e-learning courses to effectively implement affective aspects for fruitful and constructive learning. There is no gainsaying in the fact that effective implementation of affective aspects in e-learning is the need of the hour.

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