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Real Time Face-Recognition Based Attendance Generation and Perception Level Extraction

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Abstract: Automatic face recognition and utilization of facial expressions is fast becoming an area of heightened interest in research oriented fields such as machine vision and creation of smart, artificially intelligent systems. In this paper we present the application of these concepts in automating the attendance generation of students in academic institutions and additionally acquiring feedback based on analysis of real-time expressions of the populous to contemplate further conduction of certain workshops, ascertain the level of interest shown in a subject or a faculty's lecture etc. Such automated systems will help largely reduce the manual labor and discrepancies otherwise involved in attendance maintenance and also provide us with dependable results from real time analysis rather than paper based feedback regimes.

Key words: Facial Detection · Facial Recognition · Expressions Analysis · Neural Network

INTRODUCTION

In the modern computing era, utilization of the human face in, automation and expediting of any legacy system and, accession of the credibility of available information has steadily gained ground. However, this poses a challenging problem, due to the huge variation in the appearance of each character [1]. Human facial detection and recognition have the potential of creating dynamic, robust and potent systems which can help prevent fraudulent activities and provide improved security. Consequently, human expressions are instrumental in revealing a lot of implicit information that may not be otherwise easily discernible. One proposed usage of these concepts will be their collaboration with attendance marking in institutional systems. With the help of the student database offered by the institution and the faces detected by the classroom cameras, the application will remove the need to manually mark the attendance for the faculty concerned by conducting matching functions of the faces detected in real time against those stored in non real time. Furthermore, the system performs an in-depth sensitivity analysis by detecting the expressions of the human face and utilizing them in creating statistical accounts of the level of interest and emotion shown by a human subject under a particular circumstance, e.g. interest shown by students in classroom lectures or seminars. When pitted against the storage requirements of manually provided feedback, as well as, the effort requirements of accessing such feedback for the intention of making future decisions, such intelligent systems make work easy and swift. There are existing systems that utilize face detection and recognition in their operations, but due to presence of noise in images, the performance of such systems is often hindered. The focus of this paper is to meditate upon and suggest ways of improving the quality of images captured and their subsequent processing.

This paper is divided into 5 sections:

Section I is the Introduction which gives an overview as to what this paper deliberates on, what it entails, the purpose of choosing to work in the said arena and a proposal of the work to be done.

Section II encompasses the related work that has been done in the field of Facial Detection and Recognition as well as Expression Analysis by various authors.

Section III is the proposed model that enumerates the steps in implementing the aforementioned concepts in order to automate attendance generation in institutional systems as well as extract real time feedback based on Expression Analysis.

Section IV tabulates the tools and technology utilized in developing the said software.

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Section V is about the Results and Discussion wherein implementation of the software developed as part of this paper is illustrated and the results discussed.

Related Work: Every software which deals in the human face recognition and processing of the features of the human faces during the display of varying emotions, requires a prior in-depth study into the most apt, robust and efficient technique that can be adopted for the process, prior work if any that has been done in the field and the extent of elaborate research conducted in the area. Considerable work has been done in the area of face detection and recognition with recent focus being on the extraction of perception levels [1]. Jitao Sang, Changsheng Xu, propose a global face-name graph matching based framework for robust movie character identification. The proposed scheme belong to the global matching based category, where external script resources are utilized. To improve the robustness, the ordinal graph is employed for face and name graph representation and a novel graph matching algorithm called Error Correcting Graph Matching (ECGM) is introduced [2]. Pantic and Rothkrantz devised a multi-detector approach to localization of facial feature is used to spatially sample the profile contour and the contours of the facial components such as the eyes and the mouth. A recognition rate of 86% is achieved [3]. Rowley *et al*. propose a neural network-based algorithm to detect upright, frontal perspectives of faces in gray-scale images. The algorithm works by implementing one or more neural networks directly to segments of the input image and adjudicating their results. Each network is trained to identify the presence or absence of a face [4]. Ming Hsuan Yang *et al*. discuss approaches to detect faces in images and the purpose of their paper is to categorize and evaluate these approaches, identify their limitations and propose remedial measures: Knowledge based, Feature Invariant, Template Matching and Appearance based approaches housing algorithms such as PCA, Neural Networks etc. [5]. Shahrin Azuan Nazeer et al. discuss that recent methods have been conscientious with building a robust system that focuses on both representation and recognition using artificial Neural Networks. It then evaluates the performance of the system by applying two photometric normalization techniques: histogram equalization and homomorphic filtering and comparing with Euclidean Distance and Normalized Correlation classifiers [6]. Steve Lawrence et al. combines local image sampling, a self-organizing map neural network and a convolutional neural network in order to identify two broad categories of face recognition: We wish to locate a person from a large database of faces (e.g., in a police database), OR, we wish to identify individual persons in real-time (e.g., in a security monitoring system) [7]. L. Ma & K. Khorasani introduce a technique for facial expression recognition, which incorporates the two-dimensional discrete cosine transform over the entire image as a feature detector and a constructive one-hidden-layer feedforward neural network to classify facial expression. The neural network-based recognition methods are found to be particularly promising [8], [9], since the neural networks can easily implement the mapping from the feature space of face images to the facial expression space [10]. Petar S. Aleksic *et al*. present an automatic multistream HMM facial expression recognition system and ascertain that its performance is notably improved by modeling the dependability of different streams of facial expression information utilizing multistream hidden Markov Models (HMMs). The proposed system utilizes facial animation parameters (FAPs), supported by the MPEG-4 standard, as features for facial expression classification.

Proposed Work: In view of the background of related work on Face Recognition and Expressions Analysis using various algorithms described above, the authors have been able to propose an extensive use of Neural Network for detecting & recognizing faces as well as analyzing facial expressions in varied fields. It is an effective model for feature detection and analysis in faces providing us with high accuracy and promising results when used on a very large scale.

In order to describe the work being done by us, it has been broadly divided into two separate tasks. Firstly, to generate attendance via Face Detection & Matching and secondly, to generate feedback of student interest levels based on Facial Expression Analysis; the two tasks are not consequential to one another, rather, two separate applications of Facial Detection and Recognition within the same software:

Module 1: Attendance Generation via Face Detection and Recognition (i.e. Matching)

Step 1: Create a database of images from the real-time snapshots of students' faces which will serve as the training set for facial detection and matching purposes.

Step 2: During attendance marking, each student will present himself before a webcam wherein his snapshot will be taken.

Step 3: This current snapshot will be matched against the training set of images. On finding a perfect match the student is immediately marked present in the attendance database whereas on non-recognition of any face the concerned faculty is informed to take appropriate further action (for instance register a new student, check for any attempts at proxy attendance etc.).

Neural network algorithms for face recognition operate by applying one or more networks directly to segments of the input image and arbitrating their results.

Such face recognition systems operate primarily in two stages: The first stage being, applying a set of filters based on neural network to an image and then use an arbitrator to combine the outputs. Then the arbitrator will merge detected portions from individual filters and eliminates overlapping detection.

Step 4: At the end of attendance marking, a report, denoting the number of students present along with the list of absentees, is generated.

Module 2: Generating feedback of student interest level on the basis of Facial Expression Analysis

Step 1: Create a training set of standard expressions against which the expression of the subject will be matched e.g. normal blank expression, laughing, smiling, yawning etc.

Step 2: Categorize the expressions into "Interested" and "Not Interested" categories such as a normal blank expression or smiling would express interest whereas outright laughing or yawning would be counted in disinterest.

Step 3: Capture student's face during lecture and compare it against the pre-stored database; segregating the student into "Interested" or "Not Interested" category. Here two algorithms come into play: Feedforward Neural Network and Backpropagation. A Feedforward neural network is an artificial neural network in which connections are made between units that do not form a directed cycle. In this network, the information moves in only one direction i.e. forward, from the input nodes, onto the output nodes through intermediary nodes if any. Backpropagation used in collaboration with the above algorithm, is a common method of training artificial Neural Networks and requires a set of desired outputs from inputs forming the training set against which comparisons are made and results are outputted.

Step 4: A feedback report is generated based on the number of students showing interest or not; to facilitate an assessment as to whether the concerned faculty/lecture/subject is appealing to the students. Such feedbacks would help in many institutional decision making, feedback systems and surveys.

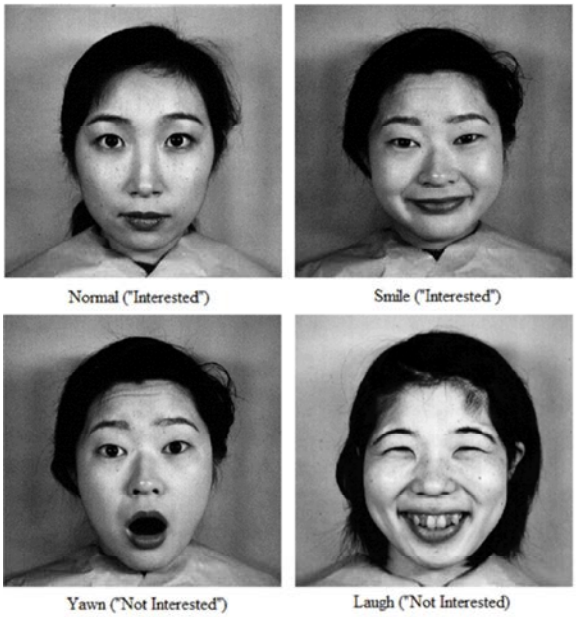

Fig. 1: A few expressions from the JAFFE database[27] and their categorization in accordance with the proposed work

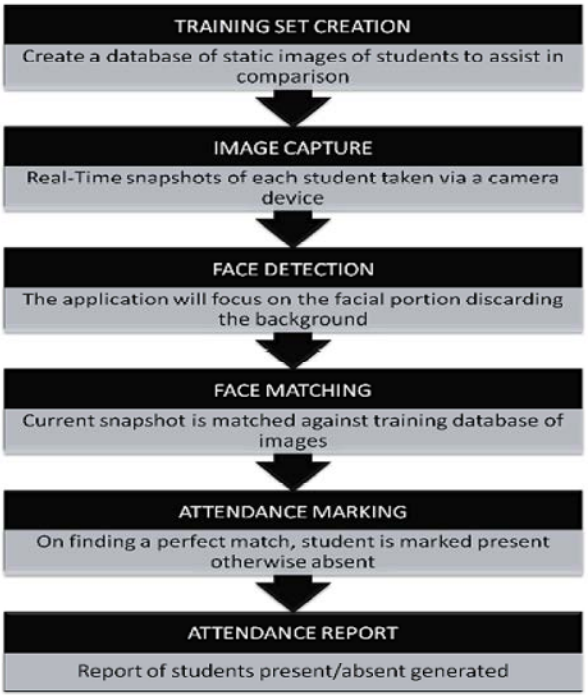

Fig. 2: Flow Chart of Module 1

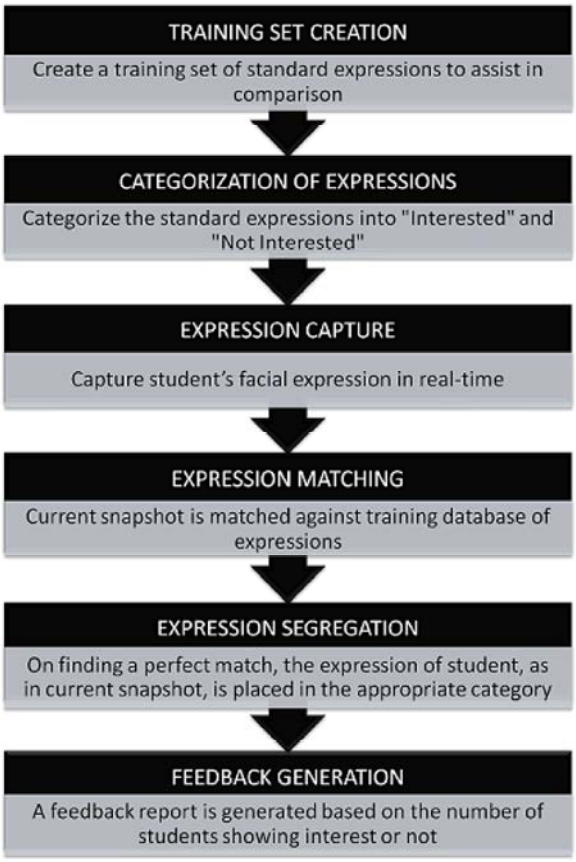

Fig. 3: Flow Chart of Module 2

RESULTS AND DISCUSSION

Executing the Application:

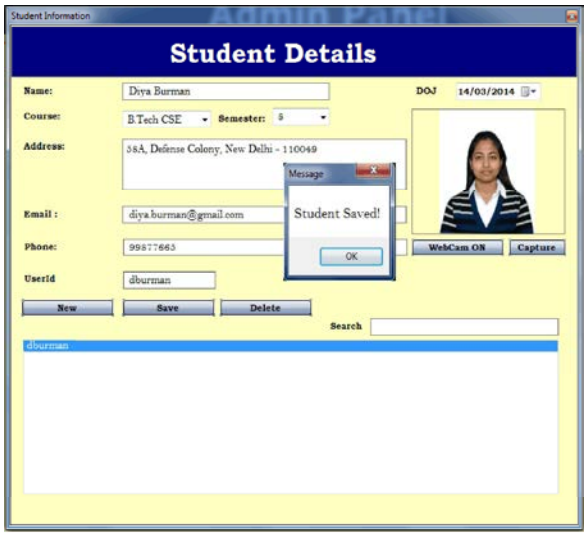

Fig. 3: Create database of images during student registration to assist Facial Matching for attendance marking purpose

Fig. 4: Attendance of Student marked on the basis of matching real-time snapshot against database image of student

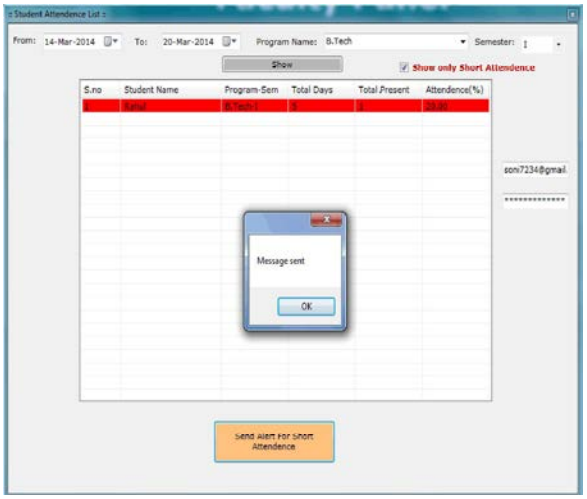

Fig. 5: In built mails may be forwarded to faculty in case of shortage of attendance.

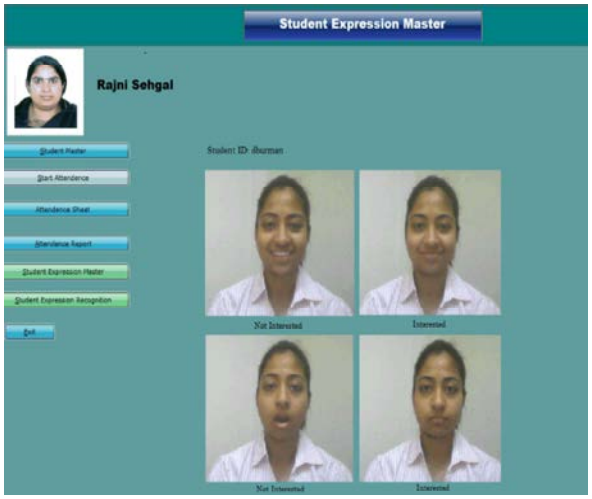

Fig. 6: Database storing expressions of individual students for future Expression Recognition

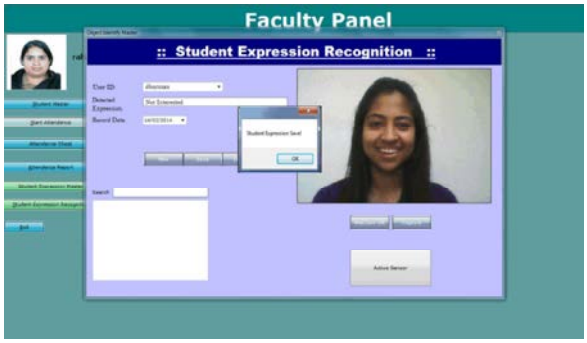

Fig. 7: Expression of student categorized into Interested/ Not Interested

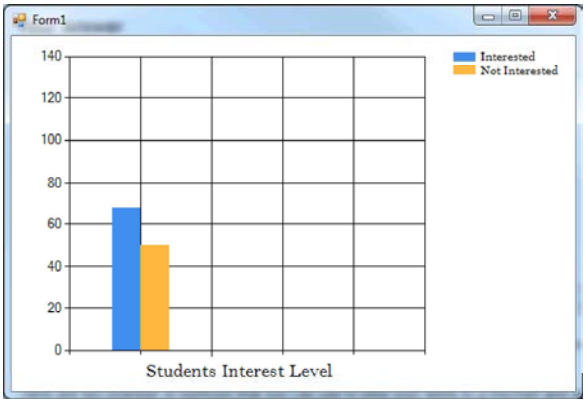

Fig. 8: Various kinds of graphs representing the reaction of the students can be generated by including counters and calculating percentages to facilitate surveys, feedback systems etc.

CONCLUSION

Over the years image processing has seen the emergence of a lot of contrivances for facial recognition and detection, but limited work has been done in extracting and utilizing human emotions and expressions in applications. Our proposed work on university faculty feedback systems is one of many angles in viewing a much larger picture. Compared to legacy systems, assay of facial expressions can help expedite a lot of manual labor that goes into the respective area of work, unnecessarily. Academic usage aside, expression recognition and analysis has an enormous scope of research and potential of usage in spheres such as criminal psychology etc.

Future Scope: This system can be aggrandized by working on meliorating the quality of detected images and cleaning up the noise to yield a more distinct and clearer image for expression extraction. Also, work can be done in enhancing the efficacy of the system at detecting distant faces with more proficiency, so larger area cum number of people could be encompassed in the radius of the system. Furthermore, the number of expressions that the system caters to can be expanded upon, including more intricate variations of seemingly same expressions.

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