A Review: Analysis of Facial Micro-Expressions

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ABSTRACT
Micro-expressions,as the name suggests,are short termed facial expressions lasting only for a fraction of seconds.They usually occur when a person either knowingly or unknowingly tries to conceal his feelings or emotions.Detection of these expressions has proven to be useful in detecting a person's mood and his real intentions.Some recent studies indicate that some leaked facial micro-expressions occuring for a very short duration of about 1/25 to 1/3 seconds can't be faked.In order to detect such expressions a high speed camera with a frame rate of 100fps or higher is required.

In this paper,various techniques used for micro-expression recognition have been analysed.Pros and cons of these techniques have also been discussed alongwith their future scope.

Keywords
Facial Micro-Expression Recognition,Static Images.

1. INTRODUCTION
Decision-making is an essential part of our day to day activities.It is the capability of mind to select between various situations and our facial expressions help us to respond accordingly.Now-a-days it is very easy to fake our expressions and this leads to incorrect decisions.Unlike facial expressions,micro-expressions are difficult to hide or fake as they are involuntary expressions visible on human faces according to emotions experienced.It would be useful in law enforcement interrogations as well as in marketing.In technical terms the facial micro expressions detection is not an easy task using traditional techniques as they appear with

low muscle intensity and to detect such micro expressions we need high speed cameras.[5]

Micro expression in psychological literature were first reported in 1960s and have been in research field since then.Computer vision methods can achieve higher accuracy in detecting facial micro-expressions unlike trained humans who can recognize micro-expressions accurately only about 47% of the time.[7]

Charles Darwin in 19th century carried out one off the most important works on facial expression analysis which possess a direct relationship with the modern date science of automatic facial expression recognition.A treatise was written by him that establish general principles of expressions in both humans as well as animals.[6]

Various kinds of expressions were grouped into similar categories by him-

- Low spirits,grief,dejection,anxiety,despair.
- Joy,devotion,love,tender feelings
- Reflection,meditation,ill-tempered,determination,sulkiness
- Hatered,anger
- Disclaim,disgust,guilt,pride
- Surprise,astonishment,fear,horror
- Aelf-attention,shame,shyness,modesty

Face expression Recognition systems have their applications in several interesting areas. Recent advances in robotics,specially humanoid robot,the urgency in the requirement of a robust expression recognition system is evident. As interaction of humans and robots has begun they have started becoming a part of our living arena. So, they need to be more intelligent regarding their understanding towards human moods and emotions.Thus,expression recognition system will help creating this intelligent vision interface between man and machine[6].

Besides having two main applications namely robotics and affect sensitive HCI other domains like telecommunications, behavioural science, video games, animations, psychiatry, educational software etc also finds its application under expression recognition system[6].

2. LITERATURE REVIEW
Authors *Iain Matthews and Simon Baker[1]* reviewed **Active Appearance Model** for detecting facial micro-expressions and put forward their findings as-Previously,AAM fitting algos fell under one of the following two categories:

a. Inefficient gradient descent algos

b. Efficient, but ad-hoc,algos.

The algo proposed for fitting AAMs that has advantages of both algo types.On the whole the proposed algo proves to be better than previos approaches in terms of:

- Covergence speed
- Convergence Frequency
- Cost of computation

Inverse compositional AAM fitting algo is applicable only to

independent AAMs not to combined AAMs.Since it is an image allignment algo,hence, most standerd extensions to image allignment can be implemented through this algo.

In order to get more accurate results,instead of using entire face for expression recognition we may work upon extracting individual features or combinition of features in future.[2]

Authors *Shishir Bashyal and Ganesh K. Venayagamoorthy[3]* reviewed **Gabor Wavelets** method for facial micro-expression recognition in which a feature vector is extracted by applying Gabor Wavelets to either the entire face or specific regions in a face and put forward their findings as-Previously,multi-layer Perceptron approach was used in Gabor Wavelet method.But,the study carried out by Shishir Bashyal and Ganesh K. Venayagamoorthy successfully used LVQ(Learning Vector Quantization) algo for facial expression recognition and Gabor filter banks as the feature extraction tool which exhibited better results with more accuracy than the previous approach.The previous approach reported having problem in classifying fear expressions but the modified approach presented here is equally good in discriminating fear expressions.

Future scope comprises of evaluating trained network's performance on other database having standard facial expressions.Modification of the present approach is being studied for the detection of mixed-emotions (for example, happiness and surprise,fear and disgust) that may occur in the human face.

Authors Ravi Kumar Bhall and Vishal Sharma[4] reviewed **Extreme Learning Machine** as a new learning algo for single layer feed forward neural networks.Challenging issues faced with traditional Single layer feed forward learning algos such as slow learning speed as well as poor generalisation capability are overcomed using ELMs.It demonstrates great potential in handeling classification as well as regression tasks with excellent generalisation performance.Its learning speed is much faster as compared to conventional gradient based iterative learning algos of single layered feed forward networks like Back Propogation algo.

In future,to increase robustness the proposed algorithm may take into consideration significant face regions including eyes, eyebrows and lips.

Authors Manar M. F. Donia and Aliaa A. A. Youssif & Atallah Hashad[5] reviewed **Histogram Of Gradient Descriptor** and proposed spontaneous facial expression recognition system for micro-exxpression analysis.The problems regarding detection and tracking of human face in videos and recognizing spontaneous expressions presented in those faces were addressed.For feature extraction a histogram orientation gradient descriptor is used.The proposeds system tested on both static images and videos and acquired results as -95% recognition rate on static images and 80% recognition rate on videos.One frontal face with no rotation at a time could be handled using present model.

In future ,more than one faces as well as rotated faces could be handled by adding an allignment step.3D image sequences could also be handled .

Authors Tomas Pfister,Xiaobai Li,Guoying Zhao,Matti Pietikainen, [8]reviewed **Temporal Interpolation** Method for facial micro-expression recognition which exhibits how to use graph embedding in order to interpolate images at arbitrary positions within a micro-expression. It allows in putting frames in a sufficient amount to feature descriptor even for very short expressions with very small number of frames and proposed their findings by describing a generic facial expression recognition cascade. The proposed method used graph embedding to temporally interpolate image sequences and inputs resulting frames into a set of classifiers.

Future work includes expanding the Single particle optical Sizing(SPOS) corpos to more participates continuing the evaluation of generic facial expression recognition framework as well as investigating alternative temporal interpolation methods.

Authors Xiaohua Huang , Su-Jing Wang , Guoying Zhao , Matti Pietikainen reviewed **Spatio-temporal local binary pattern with integral projection** method for facial micro-expression recognition in which local binary patterns from three orthogonal planes has demonstrated its efficiency for facial expression recogniotion. In this method,appearance based as well as geometry based features have been commonly used to analyse facial expressions.They proposed their works as gthe spatio temporal local binary patterns based on integral projection achieves the state of the art performance on two facial micro-expression databases.To preserve the shape property of micro-expression as well as enhance discrimiation of micro-expression integral projection based on difference images has been used.Furthermore, local binary pattern operators to describe the appearance as well as motion changes from horizontal and vertical integral projections have been presented.

On the whole an efficient and effective system for understanding micro-expressions applicable to widely potential applications was obtained

Table 1:Analysis Of various methodologies reviewed

Page Title	Methodology	Advantages	Disadavantages	Future Scope
"Active Appearance Models Revisited"	1.Active Appearance Model	Good results on using large training sets.	Requires extensive dataset with large amount of manually tagged points of the face.	work upon extracting individual features or combinition of features
"Recognition of facial expressions using Gabor wavelets and learning vector quantization"	2. Gabor Wavelets	Good in spontaneous facial motion analysis.	Requires large datasets for training an enormous number of filters.	evaluating trained network's performance on other database having standard facial expressions

"A Review:Detection and Analysis of Facial Micro-Expressions"	3. Extreme Learning Machines	High detection rate on 100fps.	Highly accurate data of The facial movement is required.	to increase robustness the proposed algorithm may take into consideration significant face regions including eyes, eyebrows and lips.
"A Review:Detection and Analysis of Facial Micro-Expressions"	4. Histogram Of Gradient Descriptor	In large scales,it provides more global information while in small scales it provides more fine grained detail.	Final descriptor vector grows larger thus taking more time to extract and to train using a given classifier.	more than one faces as well as rotated faces could be handled by adding an allignment step.
"Differentiating Spontaneous from posed facial expressions within a generic facial expression recognition framework" and "Detection and Analysis Of Facial Micro-Expressions Using Image Processing"	5.Temporal Interpolation	Detection is possible in small number of frame	Less real-time recognition	Further classification of micro-expression[10]
"Facial Micro-Expression Recognition using Spatiotemporal Local Binary Pattern with Integral Projection"	6. Spatio-temporal local binary pattern with integral projection	Allows us to preserve the shape property of micro-expression	Cannot define certain micro-expressions	To obtain a system with better understanding of micro-expression

3. CONCLUSION

In this paper, we have reviewed various methods for facial micro-expression recognition.Paper's objective was to introduce recent methodologies adapted for facial micro-expression recognition. We have studied various methods and their short-comings as:

- AAM: Requires extensive dataset with large amount of manually tagged points of the face.
- Gabor Wavelets: Requires large datasets for training an enormous number of filtersExtreme learning Machine: Highly accurate data of The facial movement is required.
- Histogram Of Gradient Descriptor: Final descriptor vector grows larger thus taking more time to extract and to train using a given classifier.
- Temporal Interpolation: Less real-time recognition
- Spatio-temporal local binary pattern with integral projection:Cannot define certain micro-expressions

We believe that this review lays the foundation for future work on algorithms for facial micro-expression recognition.The future work includes:obtaining system with better accuracy of recognizing micro-expressions by working upon extracting individual features or combinition of features as well as working upon 3d images and videos apart from working on static images.

4. REFERENCES

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