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Neurometrics, Machine Learning & Genetic Algorithms: A Literature Review

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Abstract – Facial expression is a natural nonverbal communication language. A person can express his or her sentiments/ state of mind through facial expressions but sometimes these expressions are not good enough for recognition systems, they have to be more refined to get right results. Consequently, developing a robust facial expression recognition system which can recognize facial expression in humans and can serve as an important component of natural human-machine interfaces is highly required. Support Vector Machine (SVM) among other algorithms has a very good generalization capability and dynamic classification scheme which makes it suitable for facial expression recognition. Support vector machines have previously been successfully employed in a variety of classification applications including identity and text recognition. This paper provides a brief review of researches done in the field of Genetic algorithm, Neurometrics, and Machine learning. After reviewing the existing literature the researcher feels that Genetic algorithm, Neurometrics, and Machine learning can be clubbed together to provide a framework which can help in determining the impacts of different advertisement strategies to find out the best suitable mode of advertisement for business practices.

Keywords: Neurometrics, Genetic Algorithms (GAs), Machine Learning, Facial Expression Analysis, Neuromarketing

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INTRODUCTION

Facial expression analysis is a rapidly growing field of research due to the constantly increasing interest in the feasibility of applying automatic human behaviour analysis to all kinds of multimedia recordings involving people. Human being possesses an ability of communication through facial emotions in day to day interactions with others. Some study in perceiving facial emotions has fascinated the human computer interaction environments. In recent years, there has been a growing interest in improving all aspects of interaction between humans and computers especially in the area of human emotion recognition by observing facial expressions. The research in the field of automatic facial expression analysis is focused more to six prototypic emotional facial expressions - fear, sadness, disgust, anger, surprise, and happiness. However, human emotion is composed of hundreds of expressions and thousands of emotional words, although most of them differ in subtle changes of a few facial features. On other side Neuromarketing is gaining rapid credibility and adoption among advertising and marketing professionals as it is proving as more effective and economical for testing and predicting the effectiveness of advertisements. Because it does not depend upon consumers' willingness to describe how they feel when they are exposed to an advertisement rather it capture the emotions of the customers while they are watching such commercial advertisement and hence result in greater accuracy. The facial expression analysis performed with the help of Genetic algorithms, in which the solution space is explored through recombination of previous explored solutions, and unsupervised learning techniques, where you do not need to supervise the model instead you need to allow the model to work on its own to discover information, could result in higher probability of accurate emotion prediction.

STATEMENT OF PROBLEM

The demanding, dynamic and vibrant environment supports market efforts should be customized such that there will be improvement in customer retention, sales optimization and product promotion. The most tested and effective way for improving sale are advertisements and these ways cannot be overlooked from the prospective of multichannel business. The Neuromarketing techniques, Genetic algorithms and Machine learning can prove in order to monitor facial expressions of the customers while watching

advertisements through different channels. Therefore evaluation of different advertisement strategies is required with respect to their effectiveness and to figure out the best suitable channel of advertisement for business practices.

AIM AND OBJECTIVE

The objective of this paper is to review the research work conducted/published in field of Neurometrics, Genetic algorithms and Machine learning that could help in achieving the main objective of this purposed research.

BACKGROUND OF STUDY

Neuromarketing

"Neuromarketing" loosely refers to the measurement of physiological and neural signals to gain insight into customers' motivations, preferences, and decisions, which can help inform creative advertising, product development, pricing, and other marketing areas. Brain scanning, which measures neural activity, and physiological tracking, which measures eye movement and other proxies for that activity, is the most common methods of measurement.

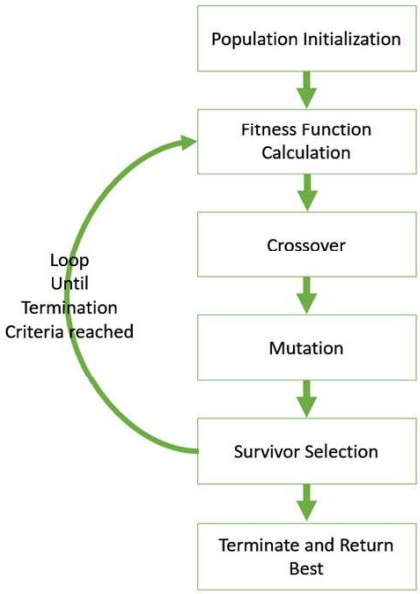
The two primary tools for scanning the brain are fMRI and EEG. The former (functional magnetic resonance imaging) uses strong magnetic fields to track changes in blood flow across the brain and is administered while a person lies inside a machine that takes continuous measurements over time. An EEG (electroencephalogram) reads brain-cell activity using sensors placed on the subject's scalp; it can track changes in activity over fractions of a second, but it does a poor job of pinpointing exactly where the activity occurs or measuring it in deep, subcortical regions of the brain (where a lot of interesting activity takes place). An fMRI can peer deep into the brain but is cumbersome, and it tracks activity only over the course of several seconds, which may miss fleeting neural incidents. (Moreover, fMRI machines are many times more expensive than EEG equipment, typically costing about $5 million with high overhead, versus about $20,000.) Tools for measuring the physiological proxies for brain activity tend to be more affordable and easier to use.

Genetic Algorithms

Genetic algorithms are a set of evolutionary computing algorithms in which the solution space is explored through recombination of previous explored solutions. In an analogy to natural selection, better solutions have more probability to be chosen for recombination, while bad solutions tend to be discarded. The result of this recombination process is an offspring of new solutions, in which individuals inherit different characteristics from their parents.

In standard GA, at first, a population of candidate solutions is randomly generated. Each solution is represented by a data structure (chromosome), containing the parameters to be tuned. These solutions are evaluated by a fitness function, representing the performance of the solution on the target problem with higher values being returned by the best solutions. In the next step, a selection algorithm is used to choose existing solutions for recombination. The chosen individuals are then subjected to the genetic operators of crossover and mutation to create an offspring of new solutions (generation). In crossover, elements of selected chromosomes are exchanged, creating new solutions inheriting characteristics of their parents. In mutation, an element of the chromosome is randomly changed, producing a new solution. The solutions in the new generation will be evaluated and will replace the previous population, optionally keeping some of its best individuals through elitism.

Genetic algorithms operate on a population of individuals to produce better and better approximations. At each generation, a new population is created by the process of selecting individuals according to their level of fitness in the problem domain, and recombining them together using operators borrowed from natural genetics. The offspring might also undergo mutation. A state diagram for the training process with the genetic algorithm is depicted next.



MACHINE LEARNING

Machine learning (ML) is the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known

as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task. Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop a conventional algorithm for effectively performing the task.

Machine learning is closely related to computational statistics, which focuses on making predictions using computers. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a field of study within machine learning, and focuses on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is also referred to as predictive analytics.

LITERATURE REVIEW

(Kashyap et al., 1990) discussed that the significant impetuses behind face portrayal, identification, and acknowledgment is the use of Eigenpictures. The authors also highlighted that in face remaking the projects like PCA or KL have been used.

The authors (Turk & Pentland, 1991) have used eigenfaces for detection of Id as well as face and these have shown fruitful results while using this concept. This idea of eigenfaces can be reached out to eigenfeatures, for example, eigeneyes, eigenmouth, and so on.

(Essa & Pentland, 1997) were discussed the uses of techniques and methods of the computer vision system to coding, interpretation, analysis and recognition of expressions related to the human face which is a concept of psychology. The authors have developed a mathematical formulation and employed a vision system based on the computers capable of a thorough analysis of facial expressions in context with a dynamic and active framework.

(Chapelle, Haffner, & Vapnik, 1999) The main objective of the researcher was to develop a method to discover an appropriate representation for these collections of images and videos. This study was focused on a method of a histogram in context with colors for the representation. The basic idea behind this was to classify the images on the commonly objects present in the images. For classification purpose the SVM technique was used because it could generate a very sound performance in generalizing the images without having the need of priori information.

(Maja Pantic & Rothkrantz, 2000) have studied the research problem related to analyzing the emotional facial expression for automatic analysis of facial expressions'. The main objective of the study was to investigate the issues in structure and usage of a framework that could perform computerized facial articulation investigation.

(Adolphs, 2002) Researchers devised a model which could be used to describe the association of the various faces which could be elaborated by the different number of aspects according to the faces and its distance from one position of the face to another position in an absolute manner.

(Maja Pantic & Rothkrantz, 2003) have discussed a concept regarding new generation i.e. human computer interaction (HCI) as affective computing. The authors have discussed the introduction, meaning and problems including- what is an affective state, what sort of proofs results about affective situations or states, and how a variety of evidence being collected to produce result about affective states, psychological issues, human performance related issues and a classification of the problem areas, of the affective computing, and the well established automatic affect acknowledgment from face images and audio signal.

(Anderson & Mcowan, 2006) have studied the computerized process and system for the recognition of facial expression of the human being. It is called the Automated System for the reorganization of facial expression. The systems provided by Anderson and McOwan have used the motions of the human face to characterize monochrome frontal views of expressions. This system uses the dynamic and cluttered scenes to effectively operate and recognize those six universally accepted unique facial expressions.

(Perronnin, Jorge, & Mensink, 2010) have focused on image classification of Fisher Kernel for Large-Scale which was revealed to expand the popular bag-of-visual-words (BOV) by going ahead of count statistics.

(Michael a. Diefenbach, Miller, & Porter, 2012) The authors have studied the emotions and health behavior of human beings. This research paper provides a detailed discussion on the emotions, behavior and health of the human being. This paper has considered emotions and health as a physiological reaction especially in women.

(Roy & Podder, 2013) This research paper elaborates on the techniques used for human face detection based on some facial features and researchers have discussed various face recognition methods.

(Hemalatha & Sumathi, 2014) The researcher has studied facial expressions especially automatically detection and classification of them. The automatically recognition of the facial expression

system is playing a significant role in the process of human-machine interfaces. It is also an important component for analyzing human facial expressions. This research work has recognized, examined and analyzed the facial expression through different methods of facial classification, facial detection and facial feature extraction.

(Martinez, 2015) In this research the authors have mentioned in short the progress of a model of the perception of face expressions of emotions which is very useful to understand the psychology of the human through his or her facial and emotional expressions.

(Zeliha Eser, 2016) This research is based on NeuroMarketing and was held in turkey. It had revealed that which part of the human brain is responsible for the decision making of purchase and helps the marketers to persuade the buyers on the basis of these findings. Neuromarketing is characterized as the use of neuroimaging methods to comprehend human conduct in connection to business sectors and marketing trade

(Bakardjieva & Kimmel, 2016) this study primarily investigated the significance of the neuromarketing in understanding the facts on the perception of the customers and their motivation to get involved in the studies related to it. The investigators devised a questionnaire to check the attitudes in connect with neuromarketing study practices, their thinking with reference to science and the involvement in neuromarketing research.

(Soleymani, Asghari-Esfeden, Fu, & Pantic, 2016) This study had focused basically on the emotions and their detection with the help of the imaging system. Emotions are related to the observable fact which is the outcome of the motivation.

(Geethu G S, 2016) This Study has focused on the facial expressions of human beings in the image sequence. This paper has been tried to explain the process of recognition of facial expressions through using a multi class SVM in image sequences. The authors have discussed the importance of non-verbal communication. They have explained the facial expression as the emotional state of the human being which helps to person to understand or know the mindset or status of the other person.

(Kamencay, P. Benco, M., Tibor, T., Hudec, R., Sykora, P., Satnik, A., 2016).The researchers have focused on the pattern recognition methods but amongst them they find the following technique more useful the Local Binary Patterns (LBP) is a surface descriptor that can likewise be utilized to speak to faces.

(Naji, Zainuddin, Jalab, Zaid, & Eldouber, 2017) The researchers presented a neural network-based strategy to distinguish frontal faces in grayscale pictures beneath unrestricted situations such as the closeness of mixture background and uncontrolled light. The framework is devised of two stages: threshold-based division and neural network-based classifier.

RESEARCH GAP

The studied in the past have shown that researchers have neither paid needed attention nor shown devotion and dedication upon the theoretical concepts which could be connected with genetic algorithms, machine learning as well as Neuromarketing. The literature have not comprised of the empirical studies that can be helpful while evaluating the techniques of Neuromarketing in case of advertisement strategies related to business. One of the core gaps with respect to the studies literature is that there is a need to implement a framework to determine the effectiveness of advertisements with respect to business.

CONCLUSION

Well, the techniques of Neuromarketing are popularly known for its effectiveness in recording or getting responses from users while it faces a lot of criticism in the areas of complexity as well as costliness in the techniques like fMRI or EEG. For implementing these, proper set-up of laboratory is required and these can be used for market research. While in minimizing complexity as well as costliness, a third innovative technique has come into market to capture the market with low cost devices or even cell phones to do in-home Neuromarketing measurements. The literature review has also highlighted that performance of devices which are cost-effective should be evaluated for any market stimulus to record the customer neurometrics. The demanding, dynamic and vibrant environment requires market efforts should be customized such that there will be improvement in customer retention, sales optimization and product promotion. The most tested and effective way for improving sale are advertisements and these ways cannot be overlooked from the prospective of multichannel business. So, evaluation of different advertisement strategies is required with respect to effectiveness and to figure out the suitable channel of advertisement for business practices. This generates the requirement to implement a framework which could connect the concepts of genetic algorithms, machine learning as well as Neuromarketing that may be used to determine the effectiveness of advertisements with respect to business.

REFERENCES

1. A. S. Mandai, RA. Patil, & V. Sahula (2011) "Automatic detection of facial feature points in image sequences" Published in International Conference on Image information Processing,

2011, Shimla, India 03-05 November 2011.

2. J. H. Holland (1992). Adaptation in Natural and Artificial Systems: An Introductory Analysis with Applications to Biology, Control, and Artificial Intelligence, MIT Press, Cambridge, MA, USA.

3. F. H. F. Leung, H. K. Lam, S. H. Ling, and P. K. S. Tam (2003). "Tuning of the structure and parameters of a neural network using an improved genetic algorithm," IEEE Transactions on Neural Networks, vol. 14, no. 1, pp. 79–88.

4. S. Russel and P. Norvig (2009). Artificial Intelligence: A Modern Approach, Pearson, London, UK, 3rd edition.

5. M. Mitchell (1998) an Introduction to Genetic Algorithms, MIT Press, Cambridge, MA, USA.

6. Bishop, C. M. (2006). Pattern Recognition and Machine Learning, Springer, ISBN 978-0-387-31073-2

7. Kashyap, R. L., Paulik, M. J., Loh, N., Automation, A., Jain, A. K., Jenkins, G. M., … Sirovich, L. (1990b). Application of the Karhunen-Loeve procedure for the characterization of human faces - Pattern Analysis and Machine Intelligence, IEEE Transactions on, 12(4)

8. Turk, M., & Pentland, A. (1991). Eigenfaces for recognition. Journal of Cognitive Neuroscience, 3(1), pp. 71–86

9. Essa, I. A., & Pentland, A. P. (1997). Short Papers. IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, 19(7), pp. 757–763.

10. Chapelle, O., Haffner, P., & Vapnik, V. N. (1999). Support vector machines for histogram-based image classification. IEEE Transactions on Neural Networks, 10(5), pp. 1055–1064. https://doi.org/10.1109/72.788646

11. Adolphs, R. (2002). Recognizing Emotion From Facial Expressions : Behavioral and Cognitive Neuroscience Reviews, 1(1), pp. 21–62. https://doi.org/10.1177/1534582302001001003

12. Anderson, K., & Mcowan, P. W. (2006). A Real-Time Automated System for the Recognition of Human Facial Expressions. IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS, 36(1), pp. 96–105

13. Perronnin, F., Jorge, S., & Mensink, T. (2010). Improving the Fisher Kernel for Large-Scale Image Classification. European Conference on Computer Vision, pp. 143–156.

14. Michael a. Diefenbach, Miller, S. M., & Porter, M. (2012). Handbook of Emotions (3rd Edition) Handbook of Emotions (3rd Edition). Handbook of Emotions, 3, pp. 661–676.

15. Roy, S., & Podder, S. (2013). Face detection and its applications. International Journal of Research in Engineering & Advanced Technology, 1(2), pp. 1–10.

16. Hemalatha, G., & Sumathi, C. P. (2014). A Study of Techniques for Facial Detection and. International Journal of Computer Science & Engineering Survey, 5(2), pp. 27–37.

17. Martinez, A. (2015). A Model of the Perception of Facial Expressions of Emotion by Humans : Research Overview and Perspectives. Current Oipnion in Psychology, 13(2012), pp. 1589–1608

18. Zeliha Eser, F. B. I. & M. T. (2016). Perceptions of marketing academics , neurologists , and marketing professionals about neuromarketing Perceptions of marketing academics , neurologists , and marketing professionals about. Perceptions of Marketing Academics, Neurologists, and Marketing Professionals about Neuromarketing, 27(July 2011), pp. 855–868. https://doi.org/10.1080/02672571003719070

19. Bakardjieva, E., & Kimmel, A. J. (2016). Neuromarketing Research Practices: Attitudes, Ethics, and Behavioral Intentions. Ethics & Behavior, 8422(April), pp. 53. https://doi.org/10.1080/10508422.2016.1162719

20. Soleymani, M., Asghari-Esfeden, S., Fu, Y., & Pantic, M. (2016). IEEE TRANSACTIONS ON AFFECTIVE COMPUTING Analysis of EEG signals and facial expressions for continuous emotion detection. IEEE TRANSACTIONS ON

AFFECTIVE COMPUTING, 7(1), pp. 17–28. https://doi.org/10.1109/TAFFC.2015.2436926

21. Geethu G S, K. T. (2016). Recognition of Facial Expressions in Image Sequence using Multi-Class SVM. International Journal of Innovative Research in Computer and Communication Engineering, 4(8), pp. 14630–14638. https://doi.org/10.15680/IJIRCCE.2016

22. (Kamencay, P. Benco, M., Tibor, T., Hudec, R., Sykora, P., Satnik, A., 2016. Accurate wild animal recognition using PCA, LDA and LBPH published in ELEKTRO-2016, IEEE Conference, 16-18 May 2016 doi.org/10.1109/ELEKTRO.2016.7512016

23. Naji, S., Zainuddin, R., Jalab, H. A., Zaid, M. A., & Eldouber, A. (2017). Neural Network-Based Face Detection with Partial Face Pattern Neural Network-Based Face Detection with Partial Face Pattern. The 2011 International Arab Conference on Information Technology ACIT 2011, 1(June), pp. 2–8.

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