A Novel Methodology for Disease Identification using Metaheuristic Algorithm and Aura Image

Manjula Poojary, Yarramalle Srinivas
Department of Computer Science, GITAM Deemed to be University
Visakhapatnam, India

***Abstract*—Every human has a specific Aura. Every organism in the human body emits energy comprising of Ultra Violet radiation, thermal radiation, and electromagnetic radiation. These energy levels help to underline the physical health inside the human body. In general, these energy levels are called Aura. In order to capture the energy levels, specific cameras like Kirlian are used. These cameras try to capture the energy distribution and map them to the individual organs of the human body. In this article, we present a methodology using Image processing techniques, where Bivariate Gaussian Mixture Model (BGMM) is considered as a classifier to identify the diseases in humans based on the energy distribution. In this article, we have considered five different categories of diseased organs that are identified based on the energy distribution. The preprocessing is subjected to the morphological technique and Particle Swarm Optimization (PSO) algorithm is considered for feature extraction. The segmentation process is carried out using the feature extracted and training is carried out using the BGMM classifier. The result obtained is summarized using various other methods like Support Vector Machine (SVM), Artificial Neural Network (ANN), and Multiclass SVM (MSVM). The results showcase that the proposed methodology exhibits recognition accuracy at 90%.**

Keywords—Aura images; BGMM; image classification; multiclass SVM; artificial neural network

I. Introduction

Image processing is the primary step in image analysis. It helps to both process the image, and enhance the image and also helps in the effective recognition of deformities inside the image regions based on the feature extraction techniques [1]. In image processing the primary objective is to process the input image so that effective recognition can be achieved [2]. Among the various application of image processing recently much emphasis is subjected to the area of medical imaging. In medical imaging the acquired medical images are processed, enhanced and the features are extracted for the effective identification of the disease [3, 4]. Of late, many article have been proposed for effective identification of image deformities based on the medical images as inputs. Some of the techniques in this area of research include; methodologies based on non-parametric technique such as pixel-based techniques, region-based techniques, shape based, texture-based techniques etc. [5, 6, 7, 8]. The research is also extended further by developing parametric models for better classification and identification of medical diseases using methodologies like GMM, Hidden Markovian Models, Markovian Random fields etc. [9, 10, 11, 12]. It is also presented in the literature that parametric model-based approach is more adaptive compared to the non-parametric model [13, 14, 15, 16]. The latest advancement in the area of computer communication technologies led towards the development of machine learning technique and thereby literature has been driven in this direction of research, using machine learning technique such as Convolution Neural Network (CNN), Artificial Neural Network (ANN), Bayesian belief network etc. [17, 18, 19, 20]. However, in spite of the numerous works presented by the authors, effective identification and diagnosis is only subjected after the acquisition of medical scans and by then the disease might have entered the human anatomy. However very little work is reported in the literature to estimate the deformities inside the human body well before the disease is noticed.

This article attempts in this area of research where the Aura images are considered and using the Aura images as the input, prior detection of the disease can be identified even before the development of the disease. For this purpose, we have considered the database of Aura images, namely; Bio-Well data set consisting of Aura images. In this article we have tried to highlight the diseases like nervous system, thorax, thyroid, abdomen disease and throat diseases. The article is further presented in the following sections, where Section II deals with the brief introduction to Aura images, Section III deals with dataset considered. Feature extraction based on the PSO is highlighted in Section IV of the article. Section V deals with classification technique based on BGMM and methodology is highlighted in the corresponding Section VI. The results derived are compared with the existing algorithm and are presented in corresponding results Section VII of the article. Section VIII of the article summarizes with conclusion.

II. Aura Images

The Aura images are nothing but the energy field surrounding the human. Every individual is attributed with a specific Aura. The Aura images exhibit different colors in tandem with the colors of VIBGYOR, where each color is related to the chakras of the human body. The violet color in the colors of VIBGYOR indicates crown chakra, indigo specifies the third eye chakra, blue indicates throat chakra, green indicates the heart chakra, yellow color indicates the solar plexus, orange color indicates the sacral chakra and red indicates the base chakra. Each of the colors corresponding to the chakras are linked with an organ in the human body and they exhibit the behavior of the individual. The red color indicates the anxiety levels and the orange color represents the structure of the kidney or reproductive organ, yellow is subjected to the spleen, the working condition of lungs can be identified by the green color, throat and thyroid are reflected by the blue color, the nervous system problem can be identified by the violet and indigo color is subjected to the problem related to lungs. The main advantage of the Aura images is that, if the intensity around each chakra is identified, the specific disease which is likely to appear can be known in prior by the higher intensity depicted in these colors [20, 21].

III. Bio-Well Dataset

Bio-Well dataset records a large number of human aura images that are captured using a device called Gas Discharge Visualization (GDV), which is based entirely on Electro photonic imaging (EPI). These images are used for imaging analysis to identify many of the physical problems associated with the person. The GDV device captures the electronic cloud on the finger, those electronic images or finger images are transmitted to the GDV device for image processing. The images obtained from GDV are processed. The Bio-Well database includes aura images associated with the fingers, full aura images of the body plus aura images associated with the chakras of the human body. Bio-Well image provides a person with a wide range of seals and observations about strength and endurance for the whole body, energy centers, organs and systems. Bio-Well is used by hundreds of physicians, clinicians and researchers around the world.

IV. Particle Swarm Optimization Algorithm (PSO)

PSO is metaheuristic, populace is primarily based totally on stochastic seek set of rules stimulated with the aid of using social conduct of birds flocking at the same time while trying to find the food. Here every particle represents bird and they are able to fly in unique route and every particle has speed and position and swarm represents group of birds or populace. The idea of food searching behavior of birds is used to mathematically model the algorithm. This algorithm is used to solve the optimization problem and PSO seeks for maximum cost with the aid of using the iterations.

Suppose group of birds are randomly flying and attempting to find the food in a place (search area), social behavior of the birds is moving in the direction of a crowd. Assume that there is only one piece of food in a place being searched and all of the birds do not know the position of the food however they know how far they're in each iteration.

The search procedure used are

- Follow the bird that's nearest to the food.
- Birds do not know the best position.
- If any member can locate the appropriate path, rest of the members will comply with quickly. Starting with the randomly initialized populace and moving in randomly initialized directions, every particle is going through the search area and remembers the best preceding positions of itself and its neighbors. That is every particle seeks for maximum value through updating the iterations. In every iteration each particle is updated following the two best values, .i.e. pbest (best particle position) and gbest (group best particle position).

A. Mathematical Model

In PSO every particle is taken into consideration to be solution and every particle has its speed, position and fitness values. In swarm every particle remembers its position called particle_bestFitness_value(pbest), particle_bestFitness_position. A record of global_bestFitness_position(gbest) and global _bestFitness_value is maintained. Position and velocity is calculated using (1) and (2)

$$x_i^{t+1} = x_i^t + v_i^t \quad (1)$$

in which x_i^t is the previous position of the particle, v_i^t *is* particle velocity and x_i^{t+1} is current position.

$$v_{k=1}^t = wv_k^i + c_1 r_1 (xBest_i^t - x_i^t) + c_2 r_2 (gBest_i^t - x_i^t) \quad (2)$$

here w is inertia weight, c1, c2 is positive constants, r1,r2 is random values within the range[0,1].

$xBest_i^t$ is best particle position and $gBest_i^t$ is global best.

Calculate the fitness value of every particle using the objective function and pick out the best fitness value as gbest.

Algorithm

1. Initialize parameter and population
2. Calculate fitness value (optimum) for every particle. If the fitness value is the higher than best fitness value (pbest) then set new value as global best (gbest). Choose the particle with high-quality fitness value as gbest.
3. For every particle calculate speed and position. Calculate fitness value and locate gbest.
4. Repeat this method till circumstance met.
5. Replace counter t=t+1
6. Output is gbest(global best) and x_i(position)

V. Bivariate Gaussian Mixture Model (BGMM)

The image segmentation is the primary factor for image analysis and retrieval. Various colors are proposed for different image processing scenario. For various image processing scenarios, different colour models are suggested. Through the use of hue and saturation in a bivariate Gaussian mixture model (BGMM), human perception of a picture can be described in HIS (hue saturation intensity) colour space. The image is regarded as a finite mixture of BGMM for the purpose of image segmentation, with the feature vector of each image region having a bivariate Gaussian distribution. Through the use of a bivariate frequency surface and the K-means algorithm, the number of components in the mixture are determined. The model parameters are calculated by deriving the revised equations of the model parameters for the EM-algorithm. The segmentation is carried through maximizing the component likelihood. It is common to assume that the feature vector of the image follows a bivariate Normal (Gaussian) distribution when modelling the bivariate features of the image. The Probability density function of the BGMM is given by.

$$f(x_1, x_2) = \frac{1}{2\pi\sigma_1\sigma_2(\sqrt{1-p^2})} e^{-\left[\frac{1}{2(1-\rho^2)}\left[\left(\frac{x_1-\mu_1}{\sigma_1}\right)^2 - 2\rho\left(\frac{x_1-\mu_1}{\sigma_1}\right)\left(\frac{x_2-\mu_2}{\sigma_2}\right) + \left(\frac{x_2-\mu_2}{\sigma_2}\right)^2\right]\right]} \quad (3)$$

where μ_1, μ_2 are any real numbers.

$\sigma1 > 0, \sigma2 > 0; -1 <= \rho <= 1$

in which $\mu1$, $\sigma1$ are the mean and variance of the image with 1st features and $\mu2$, $\sigma2$ are the mean and variance of the image with the 2d features, ρ is referred to as the shape parameter.

If $\rho = 0$ this implies correlation (x, y) = 0. i.e.

$$f(x1, x2) = \frac{1}{2\pi\sigma1\sigma2(\sqrt{1-p2})} e^{-\left[\frac{\left[\left(\frac{x_1-\mu_1}{\sigma_1}\right)^2 + \left(\frac{x_2-\mu_2}{\sigma_2}\right)^2\right]}{2}\right]} \quad (4)$$

$$= f(x_1)(x_2) \quad (5)$$

x and y are normal variables.

Equations for first feature is

$$\sigma_1 = \frac{K_1 \pm \sqrt{{K_1}^2 - 4K_2}}{2} \quad (6)$$

$$where\ K_1 = \left(\frac{2e(x_1-\mu_1)(x_2-\mu_2)}{\sigma_2}\right)\left(\frac{-1}{2(1-\rho^2)}\right) \quad (7)$$

$$and\ K_2 = \frac{2\,(x_1-\mu_1)^2}{(1-\rho^2)} \quad (8)$$

Equation for second feature is

$$\sigma_2 = \frac{-K_3 \pm \sqrt{{K_3}^2 - 4K_4}}{2} \quad (9)$$

$$\text{where } K_3 = \frac{1}{2(1-\rho^2)} \frac{2e\,(x_1-\mu_1)(x_2-\mu_2)}{\sigma_1} \quad (10)$$

$$and\ K_4 = \frac{-\,(x_2-\mu_2)^2}{(1-\rho^2)}$$

VI. Methodology

The analysis of the disease based on the Aura images is done using the BGMM classifier by adopting the following steps.

Step 1: Morphological processing

The first step in the identification of the disease is to acquire the image and process the image. In order to have a precise enhancement it is customary to process the image by the integration of morphological technique together with segmentation so as to acquire the inherent outer Auras effectively [22]. The input image is converted to binary image and using the technique of morphology such as erosion and dilation the input image is processed. This process enhances the quality of the image and in order to further enhance the quality of the image technique like closing, Hit and Miss are used for effective smoothing and filling the holes inside the images. These processed images are considered for segmentation.

Step 2: Segmentation

In this process the images are clustered into groups such that the homogeneous pixels are together in a specific group based on a criterion obtained using the color intensity.

These intensities of pixels are given as input to the BGMM so that high intensity regions can be identified. These regions with high intensity attribute to the deformity.

Step 3: Feature extraction

The methodology carried out in two phases training and testing which is shown in Fig. 1. Each aura image of individual extracted and the high intensity levels identified from the BGMM are used to recognize the disease.

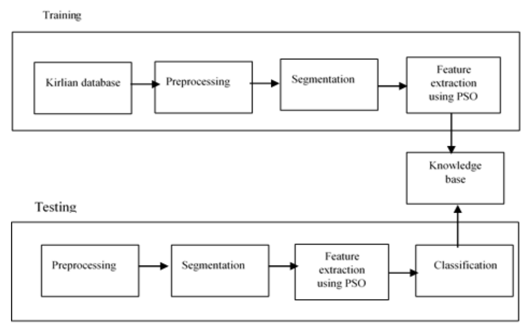

Fig. 1. Model of the Proposed Methodology.

VII. Result and Discussion

In order to present the results, the Aura images are classified based on the intensity levels. Different techniques such as ANN, MSVM and PSO with BGMM are considered for undergoing the comparative study and the various images considered are presented in Fig. 2-11. Fig. 2 shows the depleted energy distribution around neck, abdomen, leg and back. Fig. 3 indicates the energy holes in various regions due to pressure. Fig. 4 shows health issues in head, heart and abdomen region. Disease regions are indicated with breakage in the images region indicates the health problems in throat, heart, stomach and leg area due to hyper tension is shown in the Fig. 5. The aura image which was taken before meditation is given in Fig. 6. The different aura images based on the chakras is given in Fig. 7 to 11. The Fig. 7 shows the high energy levels in the heart and head regions. The problem in digestive system is observed in the Fig. 8. Health issues in the various organs shown in the Fig. 9. The Fig. 10 shows imbalanced energy level in root, solar plexus and throat chakras. Fig. 11 shows the high energy level in the root, sacral and throat chakras indicates health issues in related organs.

All the aura images are obtained from biowell data set. These images are captured using Kirlian based device called Gas discharge visualization (GDV).

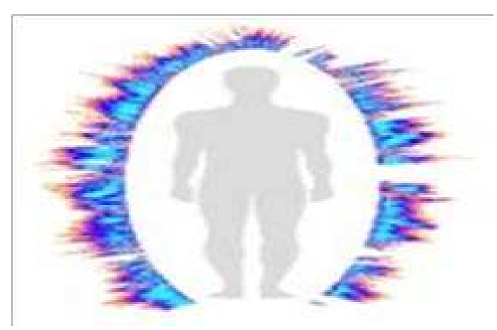

Fig. 2. Energy Depletion in Leg, Abdomen, Back and Head.

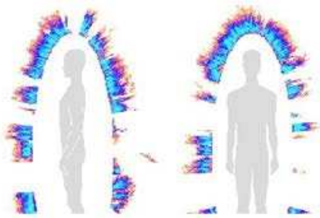

Fig. 3. Energy Holes in Various Organs.

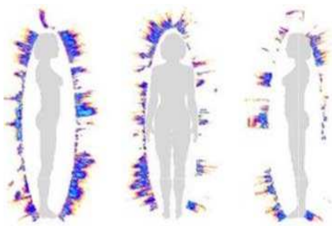

Fig. 4. Energy Depletion in the Region of Head, Heart and Abdomen.

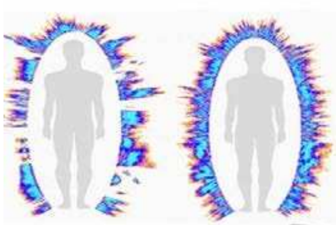

Fig. 5. Energy Holes in the Region of Throat, Heart, Stomach and Leg Area.

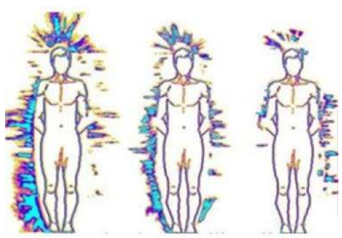

Fig. 6. Diseased Aura Image in Various Organs.

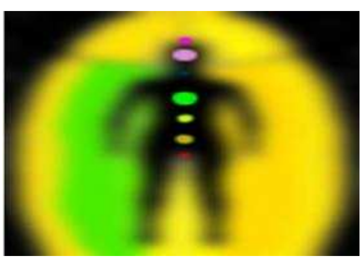

Fig. 7. Health Issues in Heart and Head (Migraine).

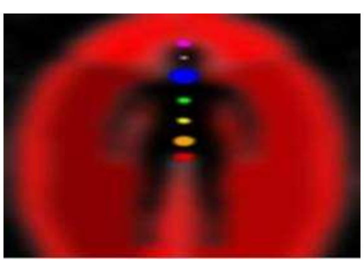

Fig. 8. Health Issues in Throat and Digestive System.

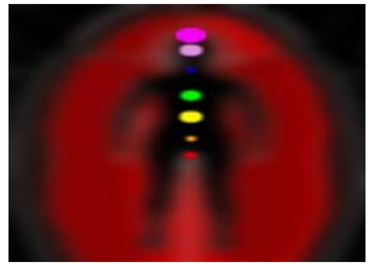

Fig. 9. Health Issues in Pineal Gland, Nervous System, Heart and Kidney.

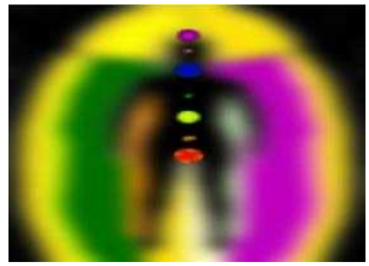

Fig. 10. Health Issues in Addrenal Gland, Solar Plexus , Throat and Brain.

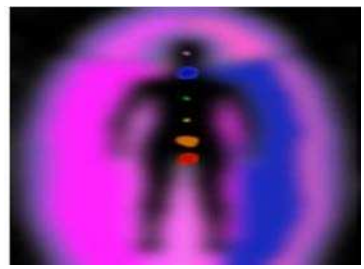

Fig. 11. Problems in Throat, Urogenital System and Spinal Cord.

The comparative analysis is carried out using technique based on ANN, MSVM technique and the proposed model based on PSO. The organs considered for the identification of the disease are nervous system, thorax, thyroid, abdomen and throat. The results obtained are depicted in the Table I. The result shows that proposed method has greater accuracy when compared to the existing model.

TABLE I. COMPARATIVE STUDY OF PROPOSED METHOD WITH OTHER METHODS

Organs having Problem	**No. of samples Trained**	**No. of samples tested**	**No. of samples recognized with ANN**	**No. of samples recognized with MSVM**	**No. of samples recognized with Proposed model**	**Accuracy (%)**
Nervous system	5	43	24	29	39	90%
Thorax	6	55	30	39	47	86%
Thyroid	7	34	12	19	29	87%
Abdomen	5	65	34	39	59	91%
Throat	7	39	21	29	32	83%

From the table it is observed that the proper methodology based on PSO helps to identify the diseases in advance compared to the other methods.

VIII. Conclusion

Aura images have a capability of disease identification. These images can be considered for the identification of the disease with respect to a specific organ. Both testing and training phases are carried out where the test image is identified based on the intensity whether it is prone to disease or not. A new methodology is considered for feature extraction based on BGMM together with PSO. The Bivariate feature H and S are given as input to the model, derived primarily based on Bivariate Gaussian distribution. It helps to identify the color intensities and thereby helps in identifying the high intensity levels resembling the disease. The comparative analysis carried out shows the proposed method helps in effective recognition of the diseases well in advance when compared to other state-of-art methods.

References

[1] Manjula Poojary and Srinivas Yarramalle, "Review of image analysis based on aura images," International Journal of Science ,Engineering and Technology, vol. 8, no. 4, pp. 1-11, 2020.

[2] Xanadu C. Halkias and Petros Maragos, "Analysis of kirlian images: feature extraction and segmentation," Proceedings of ICSP, 2004.

[3] Roeland Van Wijk and Utrecht Eduard P.A, "An introduction to human biophoton emission," Forsch Komplementarmed Klass Naturheilkd, Vol.12(2), pp. 77-83, April 2005, DOI: 10.1159/000083763.

[4] Loo Chu Kiong and Tehjoo Peng, "Quantum bioinspired invariant object recognition model on system-on-a-chip (soc), IEEE Conference on Robotics, Automation and Mechatronics, pp. 433-438, 2008, doi: 10.1109/RAMECH.2008.468138.

[5] Sitizura A. Jalil, Mohd Nasir Taib, Hasnain Abdullah, and Megawati, "Frequency radiation characteristic around the human body," IJSST, vol. 12, no. 1, DOI:10.5013/IJSSST.a.12.01.05.

[6] B. Shanmugapriya and R. Rajesh, "Understanding abnormal energy levels in aura images," Icgst Aiml-11 Conference, Dubai, Uae, pp. 12-14 April 2011.

[7] Janifalalipal, Razakmohd Ali Lee, and Alifarzamnina, "Preliminary study of kirlian image in digital electrophotonic imaging and its application," 2nd International Conference On Automatic Control And Intelligent System, Kota, Kinabalu, Malaysia, pp. 213-217, 2017, DOI: 10.1109/I2CACIS.2017.8239060.

[8] A.F Abijanska and D. S Ankowski, "Aura removal algorithm for high-temperature image quantitative analysis systems," 14th International Conference on Mixed Design of Integrated Circuits and Systems, pp. 617-621, June 2007, doi: 10.1109/MIXDES.2007.4286236.

[9] Masaki Kobayashi, Daisuke Kikuchi, and Hitoshi Okamura, "Imaging of ultraweak spontaneous photon emission from human body displaying diurnal rhythm," PLoS One, vol. 4, no. 7, July 2009, DOI:10.1371/journal.pone.0006256.

[10] Chao-Hui Huang and Danielracoceanu, "Bio-Inspired computer visual system using gpu and visual pattern assessment language (vipal): application on breast cancer prognosis," The 2010 International Joint Conference on Neural Networks (IJCNN), pp. 1-8, 2010, DOI:10.1109/IJCNN.2010.5596972.

[11] K. G. Korotkov, Peter Matravers, Dmitry V. Orlov, and M.S. Bernard O. Williams, "Application of electrophoton capture (epc) analysis based on gas discharge visualization (gdv) technique in medicine: a systematic review," The Journal of Alternative And Complementary Medicine, vol. 16, no. 1, pp. 13–25, 2010, DOI: 10.1089/acm.2008.0285.

[12] Vinitha sree subbhuraam, E. Y. K. Ng, G. Kaw, and Rajendraacharya, "Evaluation of the efficiency of biofield diagnostic system in breast cancer detection using clinical study results and classifiers," J Med Syst vol. 36, pp. 15–24, 2012, Doi 10.1007/S10916-010-9441-Z.

[13] R. Rajesh, B. Shanmugapriya, J. Satheesh Kumar, and V.Arulmozhi, "Could aura images can be treated as medical images?," Internation conference on informatic enginnering and information science, Icieis,vol. 252, pp. 159–170, 2011, https://doi.org/10.1007/978-3-642-25453-6_15.

[14] Nataliya Kostyuk, Phyadragren Cole, Natarajan meghanathan, Raphael D. Isokpehi, and Hari H. P. Cohly, "Gas discharge visualization: an imaging and modeling tool for medical biometrics", International Journal Of Biomedical Imaging, vol. 2011, Article Id 196460, 2011, Doi:10.1155/2011/196460.

[15] K. Priyadarshini, P. Thangam, and S. Gunasekaran, "Kirlan images in medical diagnosis: a survey," Int. Journal Of Computer Applications, Proceedings of International conference on Simulation in Computing Nexus, pp. 5-7,2014.

[16] John A. Ives et al., "Ultraweak photon emission as a non-invasive health assessment: a systematic review," PLoS One, vol. 9, no. 2, 2014, DOI: 10.1371/journal.pone.0087401.

[17] Shreya Prakash, Anindita Roy Chowdhury, and Anshu Gupta, "Monitoring the human health by measuring the biofield "aura": an overview," International Journal of Applied Engineering Research, Issn 0973-4562, vol. 10, no. 35, pp. 27654-27657 2015, https://www.researchgate.net/publication/277575681.

[18] G. Chhabra, N. Aparna, S. Souvik, "Human aura: a new vedic approach in IT," International Conference On Mechanical And Industrial Engineering, New Delhi, May 2013, https://www.researchgate.net/publication/280876417.

[19] Erminia Guarneri and Rauni prittinen king, "Challenges and opportunities faced by biofield practitioners in global health and medicine: a white paper," Globaladv Health Med, vol. 4, pp. 89-96, 2015, Doi: 10.7453/Gahmj.2015.024.Suppl.

[20] Himanshu kharadi and Kritika jain, "Aura-Bio energy," Proceedings Of International Conference On Emerging Technologies In Engineering, Biomedical, Management And Science, March 2016.

[21] Zhuo Wang, Niting Wang, Zehua Li, Fangyan Xiao, and Jiapei Dai, "Human high intelligence is involved in spectral redshift of biophotonic activities in the brain," Proc Natl Acad Sci U S A, vol. 113, no.31,pp. 8753-8, Aug 2016, doi: 10.1073/pnas.1604855113.

[22] Rai sachindra Prasad, Shishir Prasad, and Vikasprasad, "Pattern recognition in thought-form images using radon transform and histograms," Proceedings of the 2nd International Conference on Biomedical Signal and Image Processing(ICBIP), pp. 22-28, 2017, https://doi.org/10.1145/3133793.3133806.