

ELECTRA'21



R. C. PATEL
INSTITUTE OF TECHNOLOGY

An Autonomous Institute

**Department of
Electrical Engineering**

Vision–Mission

Institute Vision

To build electrical engineers with a global perspective and a strong dedication to Societal service.

Institute Mission

To impart high quality Technical Education through :

- Innovative and Interactive learning process and high quality, internationally recognized instructional programs.
- Fostering a scientific temper among students by the means of a liaison with the Academia, Industries and Government.
- Preparing students from diverse backgrounds to have aptitude for research and spirit of Professionalism.
- Inculcating in students a respect for fellow human beings and responsibility towards the society.

Vision

To build electrical engineers with a global perspective and a strong dedication to Societal service.

Mission

M1: To transform the students from diverse background into skilled electrical engineers.

M2: To enhance industrial interaction to meet the changing industrial needs.

M3: To serve society with deep awareness of social responsibilities and ethical values.

HOD's Message



Dr. Vijay S. Patil
Head of Department

I feel privileged to present our department's "ELECTRA'23" magazine. This magazine is intended to bring out the hidden literary talents among the students and the faculty and teach leadership skills to them.

It will be a source of inspiration for the budding writers among the students. It will direct their creativity to new dimensions of mature expression.

I sincerely thank the editorial team for their constant effort and support in bringing out the magazine in its present form. I thank our Director, Dr J. B. Patil, for their continuous support in preparing these magazine issues.

Lastly, I thank all the authors who have sent their articles.

CONTENTS

Section - 1 Technical Article

- THE WAY OF THE FUTURE
- Harnessing Solar Energy: A Sustainable Power Source for a Brighter Future
- Technologies 2050: Awesome innovations in the future
- Dancefloor generates electricity at London's first eco-disco!
- The Bendy Touchpad: A Revolutionary Innovation in User Interface Technology
- Wind Turbine Generates Electricity without Rotating Blades

Section - 2 Journal Paper

- A Comprehensive Approach to Electricity Billing Management Using Java Swing and SQL
- An Overview of Matlab/Simulink Dynamic Model of an Electric Vehicle's Performance
- Performance and Analysis of Smart Irrigation System Using Internet of Things
- Drone (Quadcopter) for Transmission Line & Solar Panel Cleaning
- Advance Manless E-Vehicle Charging Station
- ARDUINO BASED SMART DUSTBIN
- Smart Energy Meter Using Lora Protocols & IOT Applications
- Development of a Hybrid System Combining Solar and Vertical Axis Power

SECTION - I

Technical Article

2020-21

Batteries are practically essential devices but present a whole host of problems. Over time they can have trouble retaining a charge. Some stop working altogether. Others overheat or leak or even explode. They're also rigid and sometimes bulky. Then how about, instead of your standard AA or lithium-ion, a flexible, incredibly thin battery that could be powered by blood or sweat?

The battery is not only as thin as paper; it essentially is paper. At least 90 percent of the battery is made from cellulose, which makes up traditional paper and other paper products. Aligned carbon nanotubes make up the other 10 percent, give the paper its conductive abilities and also make it black. The nanotubes are imprinted in the very fabric of the paper, creating what's called a nanocomposite paper. One of the paper's authors said that the battery "looks, feels and weighs the same as paper".

Using nanotechnology, the battery's small size, flexibility and replenishing electrolyte source -- that is, as long as you eat -- make it ideal for medical applications. When using the battery away from the human body, scientists soaked the paper in an ionic fluid (a salt in liquid form), which provides the electrolytes.

The battery's paper-like construction grants it significant flexibility. The RPI research team believes that the battery could, in the future, be printed in long sheets, which could then be cut into small, custom-shaped batteries. The nanocomposite paper can have holes poked in it or be cut into unusual shapes and continue to function. Several sheets could be lumped together to power medical implants, such as pacemakers, artificial hearts or advanced prosthetics. The battery would easily fit under the skin without causing any discomfort.

Because the ionic liquid used doesn't freeze or evaporate like water, the battery could be employed at a wide range of temperatures: from -100 degrees Fahrenheit up to 300 degrees Fahrenheit. Its temperature resistance and light weight mean that manufacturers of automobiles and airplanes -- both of which require light, durable materials -- may come calling.

The researchers behind the battery claim that their device is unique because it can act "as both a high-energy battery and a high-power supercapacitor". - Supercapacitors allow for large, quick bursts of energy, potentially extending the technology's already wide range of applications.

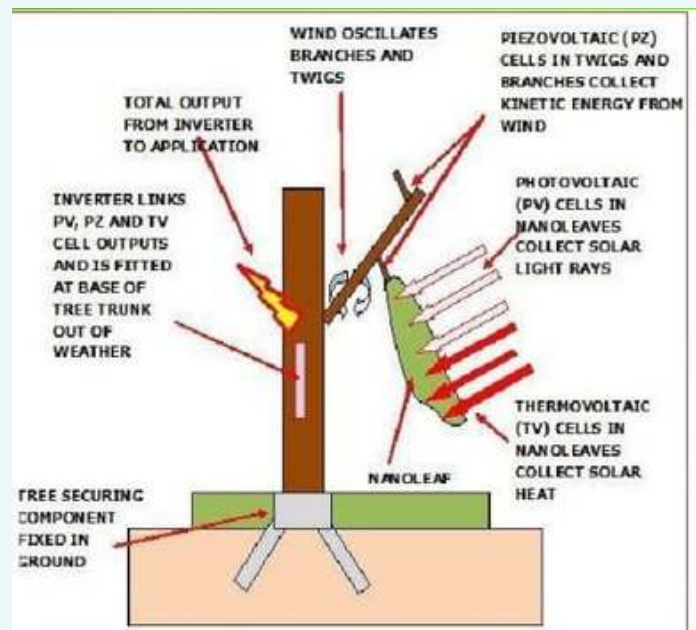
The battery, which is considered environmentally friendly because of its lack of chemicals and high cellulose content, was announced in the summer of 2007, but it may be years before it's ready to stream off production lines in long sheets. The RPI research team says that, in the meantime, they're trying to boost the battery's efficiency and to figure out the best method for production.



Harvesting energy from the environment responsibly is important, natural trees and plants do this efficiently already for millions of years. Our invention is the mimicking of this ingenious concept also referred to as bio mimicry or bio mimetic.

In particular this invention relates to the shape and form of leaves and needles and their incorporated nonmaterial's that allows the Nano leaf to harvest, capture environmental energies like solar radiation, wind and sound and turn this into electricity, the Nano leaves made from a flexible substrate, is exploited on both sides, using a process called thin-film deposition which will incorporate thermo and photovoltaic material for the purpose of converting solar radiation (light and heat) in addition we introduce piezoelectric connective elements that connect/affix the leaf to the plant or tree, this not only allows quick and secure assembly but it also serves for turning wind energy into electricity. Furthermore we intend to get our Nano leaves as close to real as possible, one way to achieve this is to emboss the leaves, creating a three-dimensional leaf surface image, which is beneficial for harvesting and capturing solar radiation. The invention advances upon all prior art artificial leaves, needles and grasses including water based plants, this method not only foresees an economical and efficient way to harvest solar radiation and wind energy via incorporation of thermo- photovoltaic and piezoelectric materials but also reveals a method for affixing artificial leaves that can harvest and capture solar radiation, wind energy and energy generated from falling rain and hail, providing an aesthetically pleasing and natural looking artificial leaves and needles that can be affixed to trees, plants, shrubs

and water based plants. Furthermore the main advantage of these Nano leaves is that these leaves are converting more energy than the solar panels. When we comprised the energy produced from Nano leaf tree to the energy produced with the solar panels, we found out that artificial Nano trees are converting solar radiation (light and heat) and wind(3 in 1) 130kwh p/in² per year 370 euro p/in and solar panels are converting sun light 90Kwh p/in² 580p/in².As far as we concern about the usage of this energy, this electrical energy can be used for driving the car which will reduce the use of the fossil fuels and can be used to enlighten the house.

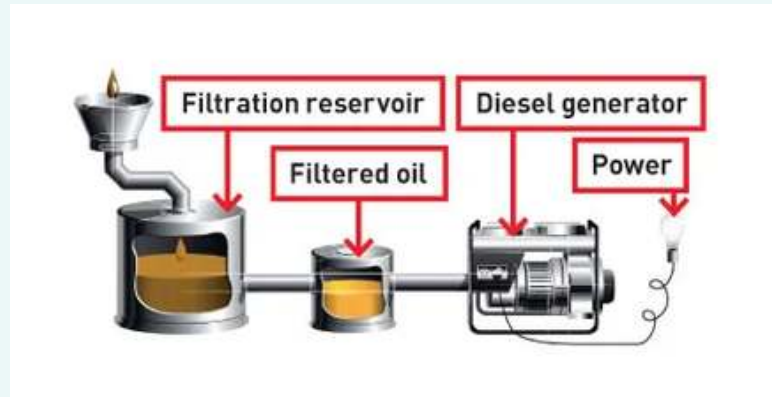


In electro catalytic performance tests at ANL, the platinum/nickel nano-frames when encapsulated in an ionic liquid exhibited a 36-fold enhancement in mass activity and 22-fold enhancement in specific activity compared with platinum nano-particles dispersed on carbon for the oxygen reduction reaction. These nano frame electro catalysts, modified by electrochemically deposited nickel hydroxide, were also tested for the hydrogen evolution reaction and showed that catalytic activity was enhanced by an order-of-magnitude over platinum/carbon catalysts. By greatly reducing the amount of platinum needed for oxygen reduction and hydrogen evolution reactions, our New class of nanocatalysts should lead to the design of next-generation catalysts with greatly reduced cost but significantly enhanced activities. "Fuel cells and electrolyzers can help meet the ever-increasing demands for electrical power while substantially reducing the emission of carbon and other atmospheric pollutants. These technologies are based on either the oxygen reduction reaction (fuel cells), or the hydrogen evolution reaction (electrolyzers). Currently, the best electro catalyst for both reactions consists of platinum nanoparticles dispersed on carbon. Though quite effective, the high cost and limited availability of platinum makes large-scale use of this approach a major challenge for both stationary and portable electrochemical applications. We needed to be able to reproduce the outstanding catalytic performance of these materials in nanoparticulates that offered high surface areas." this by transforming solid polyhedral bimetallic nanoparticles of platinum and nickel into hollow nanoframes.

The solid polyhedral nano-particles are synthesized in the reagent oleylamine, then soaked in a solvent, such as hexane or chloroform, for either two weeks at room temperature, or for 12 hours at 120 C. "In contrast to other synthesis procedures for hollow nanostructures that involve corrosion induced by harsh oxidizing agents or applied potential, our method proceeds spontaneously in air,". "The open structure of our platinum/nickel nanoframes addresses some of the major design criteria for advanced nanoscale electrocatalysts, including, high surface-to-volume ratio, 3-D surface molecular accessibility, and significantly reduced precious metal utilization.

Transforming waste vegetable oils into electricity and heat... Restaurant owners often grapple with what to do with waste oil generated from deep fat fryers, Each year more than 11 billion liters (2.9 billion U.S. gallons) of waste vegetable oil is produced by restaurants, food processing plants and fast food restaurants in the USA. Although there are regulations for proper disposal of the waste oil, most disposal options involve removal and transport of the oil to another location. Vegawatt has come up with a unique system to turn vegetable waste oil into energy at the restaurant. The very first system was just installed at a fish fry restaurant in Dedham. Waste oil recycling and energy creating compact system.

Vega watt is a unique renewable-source energy system that generates electricity and hot water, on-site, for restaurants and foodservice operations by using the waste vegetable cooking oil (WVO) from their fryers as a fuel source. Vegawatt is a 5kW unit that will provide a return of investment (ROI) of only 3 years for operations that dispose of 50 gallons per week of WVO and 2 years for operators disposing of 80 gallons each week. Our generator is fully automated; Through a proprietary process of oil cleansing, preparation and filtration the Vegawatt readies used cooking oil to be burned as a fuel in a diesel generator. Typically restaurants and foodservice operations are either paying for a grease rendering company to take this product away for use in cosmetics, soaps or in animal feed. The Vegawatt requires a footprint of only 12 square feet. It is 6 feet long, 2 feet deep and about 6 feet high. Typically it will be located at the back door or loading dock/delivery area of a restaurant or foodservice facility.



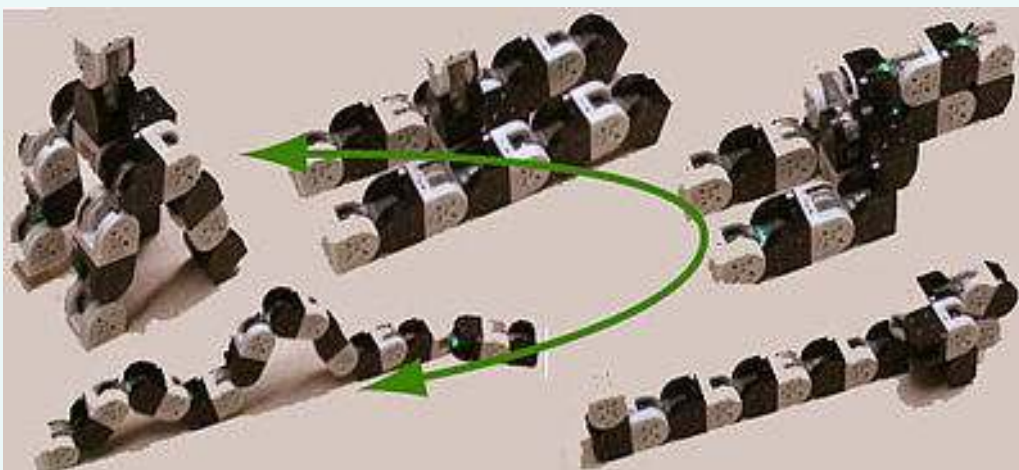
It is quiet enough in its operation that you can stand next to it and have a cell phone conversation while the Vegawatt is running. The cost savings are also a function of the cost for electricity and natural gas in the city where the Vegawatt is installed.; Typically restaurants and foodservice operations are either paying for a grease rendering company to take this product away for use in cosmetics, soaps or in animal feed. Sometimes it ends up on landfills. Other companies may use it to make bio-diesel.

Metamorphic robots are robots able to change their shape without outside help. The robots are composed of a collection of independently controlled robots that can move around on the other robot's form. The image below shows how a module moves. The module labeled S cannot move while another module is moving around it. The moving module wraps itself to another edge of the still module. Then it disconnects from the edge it started at and wraps itself back to hexagon shape. In our definition, every module has the identical structure, motion constraints, and computing capabilities. The modules also have a regular symmetry, so they can be packed without any gaps between them.

A metamorphic system can dynamically reconfigure by the locomotion of modules over their neighbors. Thus they can be viewed as a collection of connected modular robots which act together to perform the given task. The planar metamorphic robots described in this paper consist of hexagonal or square modules. Because of their shape, the modules completely fill the plane without any gaps, their centers forming a regular lattice. Both the hexagonal and square modules are provided with electromechanical coupling mechanisms actuated by D.C. Motors.

What separates metamorphic systems from other reconfigurable robots is that they possess all of the following properties: (1) self-reconfigurability without outside help; (2) a large number of homogeneous modules; and (3) physical constraints ensure contact between modules. The kinematic constraints governing a particular metamorphic robot are addressed. When making motions of the metamorphic robot, we can use not only the degrees of freedom in the joints but also the deformation of the links. In making use of the deformation by the length of the shortest path, this connects both ends of the deformed link.

These robots that can change shape and move without outside intervention are useful in environments where people cannot go. Examples of such situations are out in space, in mines, deep underwater, and in burning buildings. Having many identical modules makes the system more robust and more cost-efficient. If one module breaks down, the whole system can still continue. The modules can be mass-produced cutting down on manufacturing costs.



A properly installed lightning protection system is over 98% effective in preventing lightning damage. It is a tried and true method that has been used for over one-hundred years. With the proper lightning protection system you can rest assured that your investments, operations, and personnel will be protected. A Lightning Protection Envelope is a complete system of strike termination devices, conductors, grounding electrodes, interconnecting conductors, surge protective devices, and connectors or fittings. The conductors safely conduct the lightning current to ground, and effective low resistance grounding helps to dissipate the lightning current into the earth. The practical purpose of a lightning protection system is the safeguarding of persons and property from hazards arising from the exposure to the dangers of lightning.

The universally accepted method of protecting your valuable property from potential damage caused by lightning is a correctly designed and professionally installed lightning protection system, Alltec Corporation designs are application specific to meet your needs. The rolling sphere method is the most used method to determine the protection zone for buildings and other facilities. In this method of determining the likely points of lightning strike attachment, the sphere diameter corresponds to the "last strike" radius of selectable sizes of lightning currents, as established by modern scientific testing and investigation. The areas touched by the sphere are deemed to require protection. On tall structures, this can obviously include the sides of the facility. In addition, all possible placements of the sphere must be considered when determining the zone of protection using the rolling sphere method.



Lightning shielding analysis using the rolling sphere method can also be performed using special software. The red dots indicate the direct lightning strike point corresponding to rolling the sphere with radius 30 meter. This type of computer modeling aids in determining the required number of lightning air terminals or protection measures to prevent direct lightning strikes to any elevated part of the structure. Any available lightning protection standard may be used, with corresponding protection levels, to determine the lightning air terminals required to protect the structure.

SECTION - II

Journal Papers

Content Based Image Retrieval using Deep Convolutional Variational Autoencoder

Content Based Image Retrieval using Deep Convolutional Variational Autoencoder

Pramod Jagan Deore¹, Vijay Shrinath Patil^{2*} & Vaishali B Patil³

1, 2*Department of Electronics and Telecommunication Engineering, R. C. Patel Institute of Technology, Shirpur - 425405, India.

3 Department: Master of Computer Application, R. C. Patel Educational Trust's, Institute of Management Research and Development, Shirpur - 425405, India.

E-mail: * vijayshri12@gmail.com

Abstract: Content Based Image Retrieval (CBIR) is still a challenging task because of huge amount of image data available on social media. There are traditional machine learning methods available to solve this problem, but either the results are not up to the mark or too complex to use. Hence, in this paper, a novel, simple and fast unsupervised method for CBIR is proposed using Deep Convolutional Variational Autoencoder (DCVAE) and Nearest Neighbours (NN). The encode representation of DCVAE is used as auto-detected features for visual content representation of images. Based on the distance between the code of query image and the codes of images in the database, the relevant images are retrieved. The experimentation is carried out with databases provided in the keras library like, Modified National Institute of Standards and Technology (MNIST), Fashion- MNIST. The experimentation is carried on other database like corel database which is not available in keras library but it is publicly available database and used by many researchers for CBIR experimentation. Experimentally it has been observed that the proposed method is able to improve the mean average Precision up to 0.878, 0.853 and 0.867 for MNIST database, Fashion- MNIST database and corel database respectively

Keywords: Content Based Image Retrieval (CBIR); Deep Convolutional Variational Autoencoder (DCVAE); Nearest Neighbours (NN); Deep Neural Network (DNN); Convolutional Neural Network (CNN); Deep Learning

1. INTRODUCTION

Nowadays, use of deep learning frameworks is spreading across most of the image processing applications. Because of automatic feature extraction and greatly improved performance as compared to traditional machine learning methods. Many researchers, academicians and industries are preferring deep learning frameworks to solve complex problems. Ease of availability of resources for computation and data collection made deep learning task simpler and popular for design and development of applications over wide areas. In this paper, one attempt is made to solve the Content Based Image Retrieval (CBIR) problem using deep learning framework. In this paper, a novel and fast unsupervised method for CBIR is proposed using Deep Convolutional Variational Autoencoder (DCVAE) and Nearest Neighbours (NN). DCVAE is one of the deep neural network (DNN) architecture used popularly by many researchers for image generation and image demonising. DCVAE differs from conventional autoencoder in learning the encoded representation with constraint. DCVAE consists of encoder and decoder. Encoder has capability to represent an image into two vectors namely mean and standard deviation of latent distribution. This capability of encoder is explored in the proposed CBIR method. To reconstruct an image from encoded representation, random sampling of similar points with mean and standard deviation from latent distribution is carried out and fed to the decoder. The encoder of DCVAE is learned in such a way as to create clusters of similar encoded representations using a loss function which is combination of mean squared error (MSE) and "Kullback-Leibler" (KL) Divergence. In turn, this learning improves the searching of nearest neighbours to query image.

* Corresponding author

2. Related Work

All The earlier methods for CBIR are mainly based on extracting visual features such as colour, texture, shape, etc. using some traditional feature extraction methods. But, as deep learning taken grip in last few years, it has replaced the handcrafted feature extraction in many applications including CBIR. Used deep Convolutional Neural Network (CNN) for representing an input image with 256 features Tzelepi, M. and Tefas (2018). They obtained Mean Average Precision (MAP) of 0.83 for unsupervised learning and 0.98 for supervised learning on Paris6k database Philbin, J. et al. (2008). Alzubi et al (2017) proposed CBIR method based on CNN with 16 features and achieved MAP of 95.7% and 88.6% on Oxford5K and Oxford105K database Philbin, J. et al. (2007) respectively. JoeYue-HeiNget. et al (2015) extracted convolutional features from CNN layers and used vector locally aggregated descriptors (VLAD) for encoding into a 128 dimension feature vector. They achieved MAP of 0.694 on Paris 6k database, 0.649 on Oxford5K database and 0.838 on Holidays database Jegou, H. et al. (2008). Wei Yu et al. (2017) extracted the convolutional features from CNN layers and achieved MAP of 0.615 and 0.914 on Oxford5K and Holidays database respectively. Razavian et al. (2014) used CNN to extract convolutional features of size 4096 and reduced the dimension to 500 features using Principal Component Analysis (PCA). They obtained MAP of 0.68, 0.79, 0.843 and 0.911 on Oxford5K, Paris6k, Holidays and UKbench database Nister, D. and Stewenius, H (2006.) respectively. Yunchao Gong et al. (2014) used multi scale order less pooling CNN (MOP-CNN) in combination with PCA and whitening to represent the image with feature dimension of 2048. They obtained MAP of 0.802 on Holidays database. After surveying the existing CBIR methods based on CNN, it has been observed that the MAP is to be improved for real time application.

It also has been observed that, lot of efforts has to put to design a full proof CNN to represent image with best convolutional features with less dimension. By taking the observations into consideration an attempt is made in this paper to represent the image with less dimensional convolutional features using Deep Convolutional Variational Autoencoder (DCVAE) and improve the MAP considerably.

3. Variational Autoencoder

Fig. 1. shows the steps for training and testing of DCVAE. The database is divided into training images and testing images. In training phase, the images from training database are given to encoder. Encoder represents the images into compressed form. Each Image is represented with two vectors namely mean and standard deviation of latent distribution. In next step, random sampling of similar points with mean and standard deviation from latent distribution is carried out and fed to the decoder. Decoder tries to reconstruct the original input images. These steps are repeated until the loss between input and reconstructed image is minimized to a predefined value. In testing phase, the images from test database are given to encoder to encode and reconstructed from the encoded representation using decoder. If DCVAE is capable of reconstructing the test images with minimum loss, then the model is used further. Otherwise, the encoder and decoder are redesigned with changes in number of convolutional layers, number of filters, size of the filters and activation function. Then the training and testing of redesigned DCVAE is carried out until the loss is minimized. In this way the best DCVAE model is selected for CBIR in the proposed method.

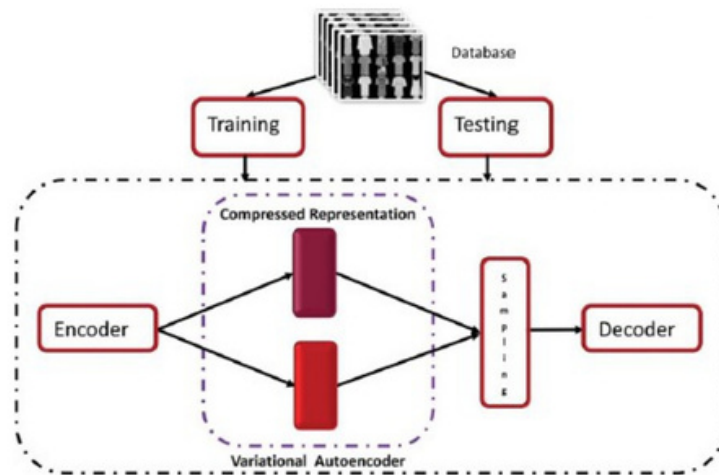


Figure 1: Variational autoencoder Training and Testing

4. Proposed method for CBIR using Deep Convolutional Variational Autoencoder

The block diagram of proposed CBIR method is shown in Fig. 2. In training phase, the encoded representation of all images from training database is calculated using DCVAE and saved in a file. In testing phase, the encoded representation of query image from testing database is calculated using DCVAE and saved in a file. The distance between the encoded representations of query image to encoded representation of all the images in training database is calculated to find nearest neighbours. Finally, Nearest Neighbour retrieves the images in ascending order of distance to the query image.

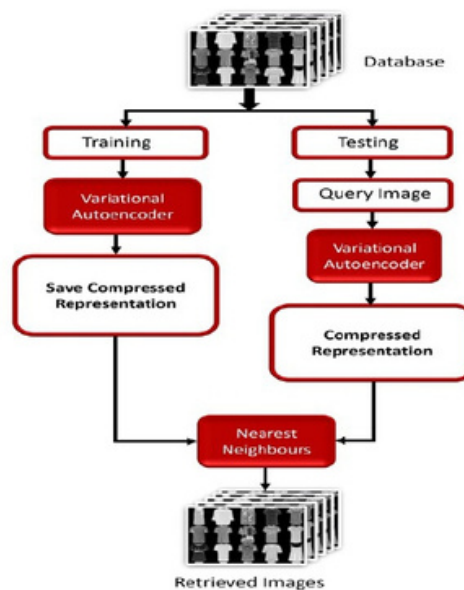


Figure 2: Block diagram of proposed CBIR method

5. Experimental Results

The experimentation is carried out using Keras API Chollet, F. et al. (2015) in python programming language. Keras platform provides databases such as Modified National Institute of Standards and Technology (MNIST) Handwritten character database Lecun, Y. et al. (1998), Fashion-MNIST database Xiao, H. et al. (2017) and Canadian Institute for Advanced Research (CIFAR) database CIFAR10 Krizhevsky, A. (2009). Keras also provides useful tutorials with examples for self-learning. Proposed method is experimented on the databases provided by keras (MNIST, Fashion- MNIST, CIFAR10) and Corel database (Li, J. and Wang, J. (2003).

5.1. MNIST Database

The MNIST database consists of 70,000 images of handwritten digits from approximately 250 writers, with 60,000 training images, and 10,000 test images. It is a subset of a larger database from National Institute of Standards and Technology (NIST) special 19 database Grother, P. J. (1995). The images are represented in grey scale with resolution of 28 X 28. The MNIST database images distribution is shown in Fig. 3. Sample images from the database are shown in Fig. 4. The distribution of test images in the database before and after encoding is shown in Fig. 5.

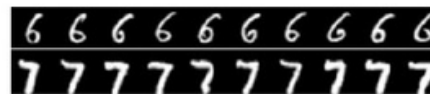
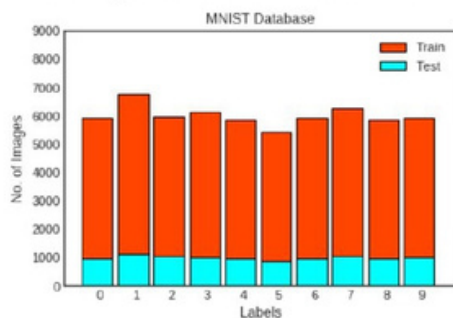


Figure 4: Sample images from MNIST database

Figure 3: The MNIST database images distribution

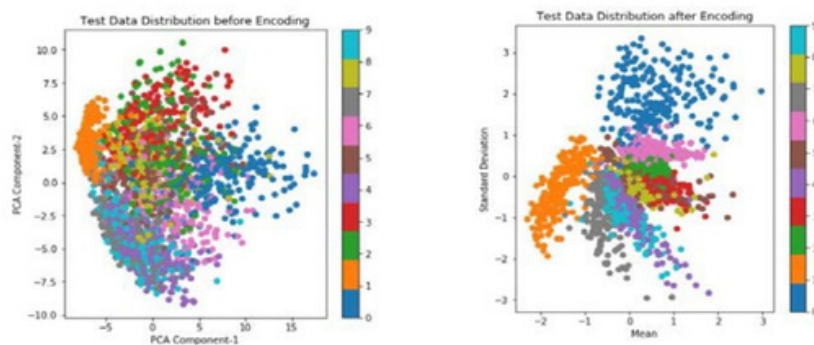


Figure 5: Test image distribution of MNIST database
 (a) Test database distribution before encoding (b) Test database distribution after encoding.

5.2. Fashion-MNIST Database

Fashion-MNIST is a dataset of Zalando’s article images consisting of 70,000 images from 10 classes with 60,000 training images and 10,000 test images. Each image is a 28 X 28 grayscale image with labels from 10 classes. The images labels consists of T-shirt/top, Trouser, Pullover, Dress, Coat, Sandal, Shirt, Sneaker, Bag and Ankle boot. The MNIST database images distribution is shown in Fig. 6. Sample images from the database are shown in Fig. 7. The distribution of test images in the database before and after encoding is shown in Fig. 8.

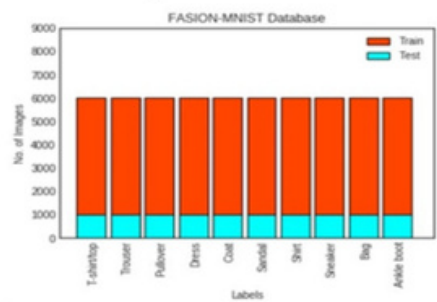


Figure 7: Sample images from Fashion-MNIST database

Figure 6: The Fashion-MNIST database images distribution

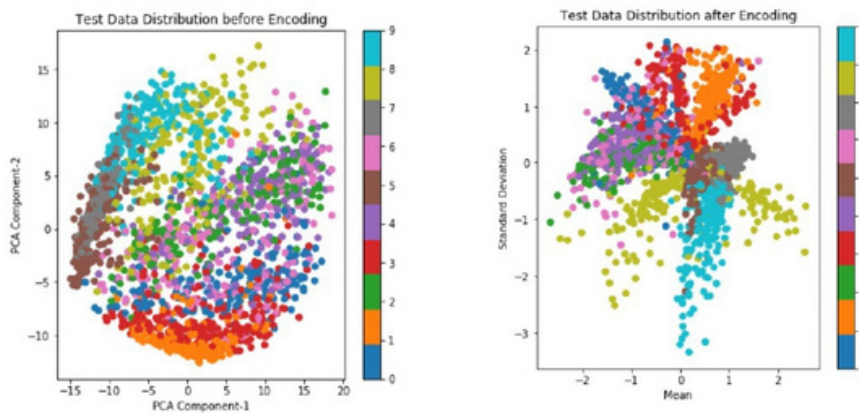


Figure 8: Test image distribution of Fashion-MNIST database (a) Test database distribution before encoding b) Test database distribution after encoding.

5.3. Corel Database

Corel database contains 10,000 color images with resolutions either 384 X 256 or 256 X 384. These images are distributed into 10 classes each containing 100 images. There are no as such names given to classes. The images are labelled with numbers from 0 to 9 for identifying the class of image. A small subset of Corel database is available named Corel1K with 100 images per class and in total 1000 images. Sample images from the database are shown in Fig. 9.



Figure 9: Sample images from corel database

Mean Average Precision (MAP) for different values of latent dimension for 10 nearest neighbours is shown in Table 1. From Table 1 it has been observed that, 10 latent dimension with 10 nearest neighbours gives best MAP. MAP goes on increasing with increase in latent dimension till 10 latent dimension, but further increase in latent dimension reduces MAP drastically.

Table 1. Table 1 Mean Average Precision (MAP) for different values of latent dimension for 10 nearest neighbours

Latent dimension	MAP (MNIST)	MAP (Fashion- MNIST)	MAP (Core1K)
2	0.815	0.793	0.802
5	0.833	0.815	0.833
10	0.878	0.853	0.867
20	0.823	0.78	0.811
50	0.783	0.74	0.775

Mean Average Precision (MAP) for different values of nearest neighbours for latent dimension of 10 is shown in Table 2. From Table 2 it has been observed that, 5 nearest neighbours with 10 latent dimension gives better MAP and MAP goes on decreasing with increase in the nearest neighbours. But, the reliable results that can be considered for the proposed method are with at least 10 nearest neighbours. Hence, the final results for proposed method for three databases are considered for 10 nearest neighbours with 10 latent dimension.

Table 2. Mean Average Precision (MAP) for different values of nearest neighbours for latent dimension of 10

Latent dimension	MAP (MNIST)	MAP (Fashion- MNIST)	MAP (Core1K)
5	0.887	0.862	0.872
10	0.878	0.853	0.867
20	0.851	0.841	0.859
50	0.822	0.807	0.834

6. Conclusion

In this paper, a novel, simple and fast unsupervised method for CBIR is proposed using Deep Convolutional Variational Autoencoder (DCVAE) and Nearest Neighbours (NN). The advantages of proposed method are as follows. As the proposed method is an unsupervised learning method, it leaves behind the tedious work of labelling the images. The images are encoded in very compact form. The proposed method gives better MAP with less dimension features. Hence, the time required for training and testing is considerably less as compared to other DNN architectures. Image retrieval is faster with great mean average precision (MAP). MAP goes on increasing with increase in latent dimension till 10 latent dimension, but further increase in latent dimension reduces MAP drastically. MAP goes on decreasing with increase in the nearest neighbours. MAP of 0.878, 0.853 and 0.867 is achieved using proposed method for MNIST database, Fashion-MNIST database and corel database respectively. In future, the efforts can be put in the direction to improve the MAP by proposing method to extract robust auto-detected features using deep convolutional variational autoencoder in combination with other deep neural network methods such as generative adversarial networks (GANs).

REFERENCES

- [1] Alzu'bi, A., Amira, A., and Ramzan, N, "Content- based image retrieval with compact deep convolutional features", *Neurocomputing*, (2017), 249:95– 105.
- [2] Chollet, F. et al. (2015). Keras. <https://keras.io>.
- [3] Gong, Y., Wang, L., Guo, R., and Lazebnik, S, "Multi-scale orderless pooling of deep convolutional activation features", In *Computer Vision – ECCV (2014)*, pages 392–407. Springer International Publishing.
- [4] Grother, P. J., "Nist handprinted forms and characters", *nist special database 19(1995)*.
- [5] Jegou, H., Douze, M., and Schmid, "C. Hamming embedding and weak geometric consistency for large scale image search", In *Lecture Notes in Computer Science*, (2008), pages 304–317 Springer Berlin Heidelberg.
- [6] Krizhevsky, A., "Learning Multiple Layers of Features from Tiny Images. Technical Report TR- 2009", (2009), University of Toronto, Toronto.
- [7] Lecun Y., Bottou L., Bengio Y. and Haffner, P., "Gradient- based learning applied to document recognition", in *Proceedings of the IEEE*, vol. 86, no. 11,(1998), pp. 2278-2324.
- [8] Ng J. Y., Yang F. and Davis L. S., "Exploiting local features from deep networks for image retrieval", *2015 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)*, Boston, MA, (2015), pp. 53-61.
- [9] Nister D. and Stewenius H., "Scalable Recognition with a Vocabulary Tree 2006" , *IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'06)*, New York, NY, (2006), USA, pp. 2161-2168.
- [10] Philbin J., Chum O., Isard M., , Sivic J. and Zisserman A., "Object retrieval with large vocabularies and fast spatial matching" , *2007 IEEE Conference on Computer Vision and Pattern Recognition*, Minneapolis, (2007) MN pp. 1-8.
- [11] Philbin J., Chum O., Isard M., Sivic J. and Zisserman A, "Lost in quantization: Improving particular object retrieval in large scale image databases", *2008 IEEE Conference on Computer Vision and Pattern Recognition*, Anchorage, AK, (2008), pp. 1-8.
- [12] Razavian, A. S., Azizpour, H., Sullivan, J., and Carlsson, S., "CNN features off-the-shelf: An astounding baseline for recognition" In *2014 IEEE Conference on Computer Vision and Pattern Recognition Workshops*. (2014) IEEE.
- [13] Tzelepi, M. and Tefas, A.' "Deep convolutional learning for content based image retrieval. *Neurocomputing*, (2018), 275:2467–2478.
- [14] Wang, J., Li, J., and Wiederhold, G., "SIMPLiCity: semantics-sensitive integrated matching for picture libraries", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, (2001), 23 (9):947–963.
- [15] Xiao, H., Rasul, K., and Vollgraf, R., "Fashion- mnist: a novel image dataset for benchmarking machine learning algorithms, (2017).
- [16] Yu, W., Yang, K., Yao, H., Sun, X., and Xu, P. Exploiting the complementary strengths of multi-layer CNN features for image retrieval. *Neurocomputing*, (2017), 237:235–241.

Design and Implementation of Mixed Signal Filter For Continuous Monitoring of ECG Signal

Design and Implementation of Mixed Signal Filter For Continuous Monitoring of ECG Signal

Mr. Vinitkumar V Patel¹, Dr. Mahesh B Dembrani²

¹. Assistant Professor, Department of Electrical Engineering, R C Patel Institute of Technology, Shirpur,

². Assistant Professor, Department of Electronics and Telecommunication Engineering, R C Patel Institute of Technology, Shirpur

Abstract:

Electrocardiogram signal comprises of several mixed signals along with desired signal. Various techniques are used to separate this mixed signal. Signal pre-processing and detection algorithm involves different classification methods such as wavelet based denoising procedure which reduces noise from the ECG signal. Distributed Arithmetic mixed signal filter is proposed in this paper through which various moving arithmetic operations are used to improve the response for real time QRS detection. This complete technique gives accurate detection of QRS wave with high memory efficiency and high speed. Performance analysis is validated by using Cardiac signal database. This analysis is based on accuracy, specificity and sensitivity which show maximum response to obtain the true conditions for ECG signal analysis.

Keywords— DA, Mixed Signal Filter, ECG Signal, QRS detection, DBE.

I. Introduction

Cardiac muscle continuously produces the electrophysiological activity which forms the Electrocardiogram normally known as ECG Signal. This ECG signal gives us the complete activities of heart working conditions. A physician normally uses the ECG signal for the diagnostics of the patient. ECG signal consist of PQRST complex waveform from that QRS complex waveform is most significant for analysis. Instantaneous heart rate (HR) relies on this QRS complex, accuracy of HR depends upon QRS detection [1] [2]. QRS complex is continuously varying which gets affected by noise signal from human organisms. Thus a suitable method is to be realized for exact detection of ECG Signal.

Digital VLSI circuits and DSP processors are normally used for the implementation of the mixed signal filter [3]-[7]. Mixed signal filters consist of analog to digital converter (ADC) and fast sample and hold circuits. Mixed signal filter is an different method to obtain power efficient circuits at a wide range of frequency. In short mixed signal design method provides a nonlinear analog circuit to design all functions required for decoding with higher speed and less power consumption to digital decoders. Digital receivers parallel analog inputs and outputs are not fully compatible with analog recorders.

An adaptive thresholding scheme is applied to perform decision making for detection of QRS complex in nonlinear LPF stage. QRS complex is detected if the peak level of feature signal exceeds the threshold value. As QRS complex wave is detected which updated the value of threshold every time [8] [9].

II. Materials and Methods

The McClellan transformation technique is applied to design 2-D FIR variable digital filters [10]. The variable filter characteristics are same as sub filter due to which they tuned with the same variable parameter. This paper focuses on the sparse FIR filter design algorithms [11]. In this paper the design is based on to reduce nonzero filter coefficients related to weighted least square approximation error imposed on frequency domain analysis. The iterative shrinkage thresholding algorithms (IST) is proposed to use for redundant and sparse representation of signals. A series of constrained sub problems in a simpler form is successively transformed from the original non convex problem in this proposed method. These sub problems can be efficiently and reliably solved in each iterative step by a numerical approach developed, despite of then on convexity. The obtained solutions are essentially optimal to their respective sub problems. The proposed algorithm [11] is computationally efficient since its major part only involves scalar operations. It is necessary to represent the coefficients of a finite impulse response (FIR) digital filter by a finite number of bits. This not only degrades the filter frequency response but also introduces a theoretical limit on the performance of the filter.

III. Proposed Methodology

From various analysis reports on filter design, it is evident that most of the filter coefficients are symmetric in nature. Coefficient sharing is one of the most effective ways of exploiting the symmetric property thereby improving the area and performance of a finite impulse response filter. Hence for our work, to make the architecture efficient the design approach herein involves designing an efficient technique for sharing the filter coefficients that are similar, thereby

reducing the number of storage devices count to half when compared to that of its counterpart. The reduction in the number of coefficient storage will also leads to the reduction in all other related components.

Since the design of coefficient sharing technique involves less hardware resource compared to the existing architecture the overhead will be less. To demonstrate the functionality and efficiency of our proposed FIR filter architecture, the filter is configured as a comb, a low-pass, and a band pass filter and compared with that of similar existing works. The proposed methodology is applied for medical application to obtain the accurate detection of the ECG Signal. Performance measures are tested for the analysis of the signal such as to obtain FPR, PPV and NPV.

IV. IMPLEMENTATION & RESULTS

In this paper the Independent Component Analysis (ICA) is used for the separation of the Noise Signal and ECG Signal. The noise signal can be due to motion artifacts or other signal from body tries to override on it. ICA is validated based on Atrial Activity (AA) and Ventricular activity (VA) generated by independent sources, AA and VA presents non-Gaussian distributions and ECG potentials from the cardioelectric sources can be considered as a narrow-band linear propagation process.

The figure 1 shows the normal ECG signal which shows the normal condition. Figure 2 shows the noise signal.ICA separates the noise signal and correctly estimates the noise and filtered ECG signal as shown in figure 3. The mean square error rate can be also calculated from the signal as shown in figure 4 the result of ICA which clearly gives the information of health by appropriate testing of the signal.

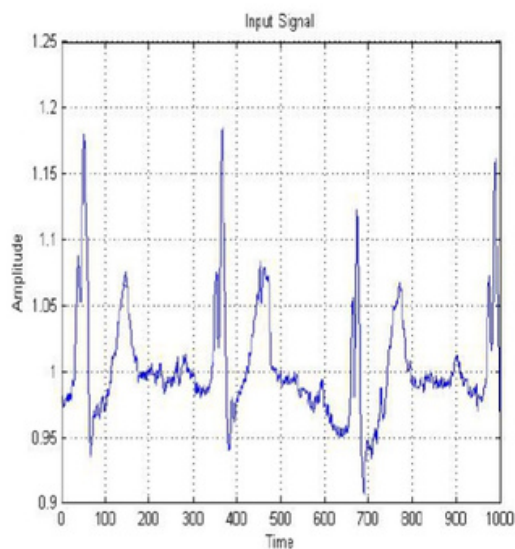


Figure 1 Normal ECG Signal

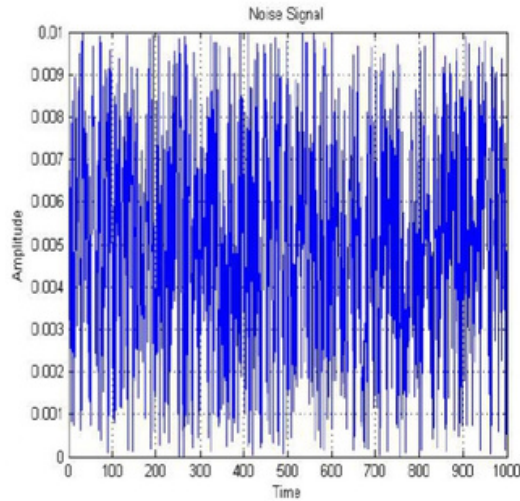


Figure 2 ECG Signal along with Noise Signal

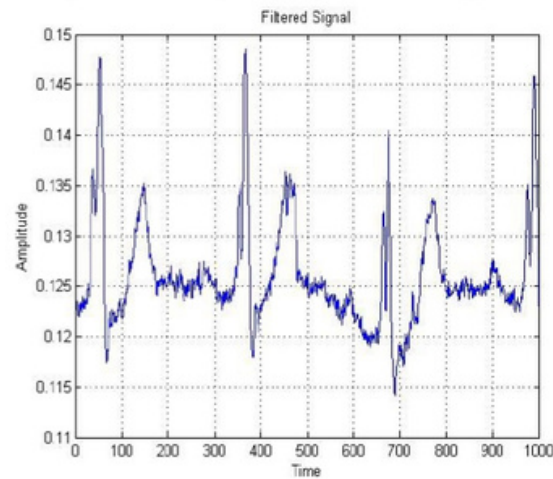


Figure 3 Accurate ECG signal Response using ICA

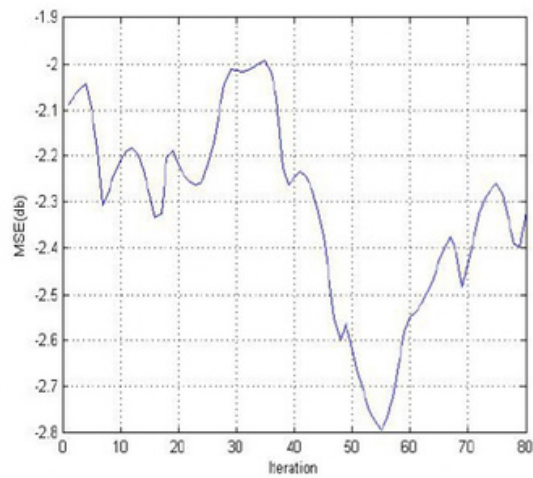


Figure 4 Mean Square Error response in (db)

4.1 Performance Measures

To Evaluate the Performance of the proposed algorithm, several terms are considered as FP (False Positive) which means false heart beat detection and FN (False Negative) which means failed to detect true heart beat rate.

4.1.1 Accuracy

Accuracy is used as a statistical measure of how a classifier and filtering techniques identifies the condition. The accuracy is the proportion of true results both true positives and true negatives among the total number of cases examined.

$$Accuracy = \frac{TP + TN}{TP + FN + TN + FP} \times 100\%$$

4.1.2 Specificity

Specificity is related to the ECG signal condition is normal (no disease). High Specificity shows that the Monitoring System obtains the Normal Condition as Normal.

$$Specificity = \frac{TN}{TN + FP} \times 100\%$$

4.1.3 Sensitivity

Sensitivity is related to the ECG signal condition is abnormal (disease). High Sensitivity shows that the Monitoring System obtains the Abnormal Condition as Abnormal.

$$Sensitivity = \frac{TP}{TP + FN} \times 100\%$$

Figure 5 shows the performance of the proposed method in terms of parameters. This shows the improvement in the performance as compared to different classification and filtering methods *with* proposed method.

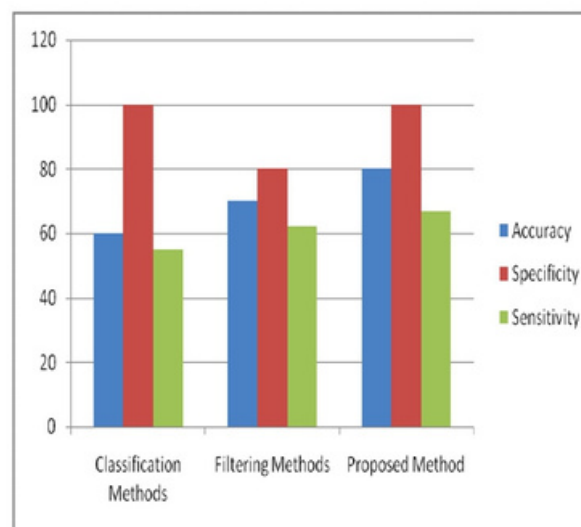


Figure 5 Graphical Representation Comparison of different methods

V. CONCLUSION

In this paper, a mixed signal DA method for real-time QRS detection is introduced. In conjunction with classification methods such as wavelet denoising for signal preprocessing the algorithm can successfully and reliably detect almost all QRS complexes for a set of noise corrupted ECG data drawn from a standard database. Moreover, according to our study it appeared that the novel thresholding strategy proposed for denoising in this study can effectively reduce the level of unstructured noise while the important features of the ECG signal. QRS complex, can be well detected accurately at the same time. In addition, the overall computational structure of the proposed algorithm allows the QRS detection to be performed in real-time with high time- and memory-efficiency. Our results also indicated that there might exist a degree of flexibility for parameter value selection as well as robustness over a wide range of noise contamination in the proposed QRS detection algorithm.

REFERENCES

1. Kohler B. U., Hennig C., Orglmeister R., 2002, The principles of software QRS detection, IEEE Eng. Med. Biol.

2. Chan H. L., Chou W. S., Chen S. W., Fang S. C., Liou C. S., Hwang Y. S., 2005, Continuous and online analysis of heart rate variability, *J. Med. Eng. Technol.* 227–234.
3. Zahabi M., Meghdadi V., Cances J., and Saemi A., 2008, Mixed-signal matched filter for high-rate communication systems, *IET Signal Processing*, vol. 2, no. 4, p. 354.
4. Milor L., 1998, A tutorial introduction to research on analog and mixed-signal circuit testing, *IEEE Transactions on Circuits and Systems II Analog and Digital Signal Processing*, vol. 45, no. 10, pp. 1389-1407.
5. Campbell D., Jones E., and Glavin M., 2009, Audio quality assessment techniques A review and recent developments, *Signal Processing*, vol. 89, no. 8, pp. 1489-1500.
6. Gudmundson M., 1991, Correlation model for shadow fading in mobile radio systems, *Electron. Letters*, vol. 27, no. 23, p. 2145.
7. Murata N., Ikeda S., and Ziehe A., 2001, An approach to blind source separation based on temporal structure of speech signals, *Neurocomputing*, vol. 41, no. 1-4, pp. 1-24.
8. Dobbs S. E., Schmitt N. M., and Ozemek H.S., 1984, QRS detection by template matching using real-time correlation on a microcomputer, *J. Clin. Eng.* 197–212.
9. Xue Q., Hu Y. H., and Tompkins W. J., 1992 Neural-network-based adaptive matched filtering for QRS detection, *IEEE Transactions on Biomedical Eng.*, pp. 317–329.
10. JyShyu Jong, Chang Soo Pei, and Huang Yun Da, 2009, Design of Variable Two Dimensional FIR Digital Filters by McClellan Transformation, *IEEE Transactions on Circuits Systems I*, vol. 56, no. 3, pp. 574-582.
11. Jiang A. and Kwan H., 2013, WLS Design of Sparse FIR Digital Filters, *IEEE Transactions on Circuits Systems I*, vol. 60, no. 1, pp. 125-135.

Variants of Artificial Bee Colony algorithm and its applications in medical image processing

Applied Soft Computing Journal 97 (2020) 106799



Contents lists available at ScienceDirect

Applied Soft Computing Journal

journal homepage: www.elsevier.com/locate/asoc



Review article

Variants of Artificial Bee Colony algorithm and its applications in medical image processing



Şaban Öztürk^{a,*}, Rehan Ahmad^b, Nadeem Akhtar^c

^a Electrical and Electronics Engineering Department, Technology Faculty, Amasya University, Amasya, Turkey

^b Faculty at Department of Electronics & Telecommunications Engineering, NMIMS, Mukesh Patel School of Technology Management and Engineering, Shirpur, Maharashtra, India

^c Faculty at Department of Electrical Engineering, R.C. Patel Institute of Technology, Shirpur, Maharashtra, India

ARTICLE INFO

Article history:

Received 20 September 2019

Received in revised form 15 August 2020

Accepted 9 October 2020

Available online 17 October 2020

Keywords:

Artificial bee colony

Optimization

Medical imaging

Literature review

ABC

ABSTRACT

The Artificial Bee Colony (ABC) technique is a highly effective method of optimization inspired by the behavior of bees. Notably, the importance of the ABC algorithm is increasing after artificial intelligence, and automatic decision-making techniques are popularized in almost every field. The analysis of images obtained from medical imaging devices attracts the attention of artificial intelligence researchers because of the importance of these images for human health. Although the ABC algorithm is very humid for medical image analysis, there is no comprehensive literature review of medical image analysis techniques. This study includes a comprehensive survey of academic studies including classification, enhancement, clustering, and segmentation of medical images using ABC. The academic studies between the years 2010–2020 are examined, and 95 studies are presented in total. 42 of these studies consist of medical image analysis studies. Of the selected studies, 20 studies are related to image classification, 15 studies are related to image enhancement, 18 academic studies are related to image clustering, and 42 studies are related to image segmentation methods. The findings of this study show that the ABC method for medical image analysis has positive effects on classification, segmentation, clustering, and enhancement methods, and the use of the ABC method has become more common. We hope that this study will help new researchers to use the ABC method.

© 2020 Elsevier B.V. All rights reserved.

Contents

1. Introduction.....	2
2. Background and research methodology	2
2.1. Artificial bee colony algorithm.....	3
2.2. Research methodology	3
3. Image enhancement using ABC	4
3.1. General image enhancement studies with ABC	4
3.2. Medical image enhancement using ABC.....	6
4. Image classification using ABC	8
4.1. General image classification studies with ABC	8
4.2. Medical image classification using ABC	10
5. Image clustering using ABC.....	12
5.1. General image clustering studies with ABC	12
5.2. Medical image clustering using ABC	16
6. Image segmentation using ABC	18
6.1. General image segmentation studies with ABC	18
6.2. Medical image segmentation using ABC.....	20
7. Discussion.....	24
8. Future direction and implication.....	25
9. Conclusion	26

* Corresponding author.

E-mail addresses: saban.ozturk@amasya.edu.tr (Ş. Öztürk), rehan.ahmad@nmims.edu (R. Ahmad), nadeem.riyaz@rcpit.ac.in (N. Akhtar).

<https://doi.org/10.1016/j.asoc.2020.106799>

1568-4946/© 2020 Elsevier B.V. All rights reserved.

Interpretation of intelligence in CNN-pooling processes: a methodological survey

Neural Computing and Applications
https://doi.org/10.1007/s00521-019-04296-5

REVIEW ARTICLE



Interpretation of intelligence in CNN-pooling processes: a methodological survey

Nadeem Akhtar¹ · U. Ragavendran¹

Received: 17 December 2018 / Accepted: 17 June 2019
© Springer-Verlag London Ltd., part of Springer Nature 2019

Abstract

The convolutional neural network architecture has different components like convolution and pooling. The pooling is crucial component placed after the convolution layer. It plays a vital role in visual recognition, detection and segmentation course to overcome the concerns like overfitting, computation time and recognition accuracy. The elementary pooling process involves down sampling of feature map by piercing into subregions. This piercing and down sampling is defined by the pooling hyperparameters, viz. stride and filter size. This down sampling process discards the irrelevant information and picks the defined global feature. The generally used global feature selection methods are average and max pooling. These methods decline, when the main element has higher or lesser intensity than the nonsignificant element. It also suffers with locus and order of nominated global feature, hence not suitable for every situation. The pooling variants are proposed by numerous researchers to overcome concern. This article presents the state of the art on selection of global feature for pooling process mainly based on four categories such as value, probability, rank and transformed domain. The value and probability-based methods use the criteria such as the way of down sampling, size of kernel, input output feature map, location of pooling, number stages and random selection based on probability value. The rank-based methods assign the rank and weight to activation; the feature is selected based on the defined criteria. The transformed domain pooling methods transform the image to other domains such as wavelet, frequency for pooling the feature.

Keywords Pooling intelligence · Hybrid machine learning tools · Supervised algorithms · Stable sampling · Deep learning methodology · Self-learning artificial neural network

1 Introduction

Convolutional neural network (CNN) architecture has different components like convolution and pooling. The pooling is crucial component placed after the convolution layer. It is also called as subsampling or down sampling layer which discard around 75% information, without affecting the information. It plays a vital role in visual recognition [1, 2], detection and segmentation course to overcome the concerns like overfitting, computation time and recognition accuracy. The few architectures of CNN

[3] do not use the pooling. The performance of deep learning architectures degrades substantially without pooling. The absence of pooling causes propagation of local feature to neighboring receptive fields which ultimately weakens the representation power of CNN, and network becomes very sensitive to input deformations. The activation in pooling regions does not have any weight and biases as like in convolution layer which do not affect the depth of feature map. The pooling operation shrinks feature map resolution and preserves the critical discriminative information required for recognition task.

It reduces the number of neuronal connections, size of feature map [4]. It does not need the zero padding and performs the defined operations on the input feature maps. Hence, it reduces the parameters, increases computational efficiency and regulates overfitting.

Ideally pooling operation preserves discriminative information while discarding irrelevant image details. It

✉ Nadeem Akhtar
nadeem.riyaz@rcpit.ac.in
U. Ragavendran
U.ragavendran@nmims.edu

¹ SVKM's NMIMS (Deemed to be University), Shirpur, India