ADVANCE ARTIFICAL INTELLIGENCE PRACTICE FOR PAROXYSM SEIZURE DETECTION

B. JOTHI[1]
Assistant Professor,
Jaya engineering college,
Thiruninravur,

Dr. D. JAYARAJ[2]
Assistant Professor, Department of computer science,
Annamalai University,
Chidambaram,

Abstract*—we have a tendency to propose a replacement approach for the detection of Epileptical victimization by image processing and deep learning methodology. A profound study of the EEG (EEG) recordings is needed for the correct detection of these epileptic seizures. Therefore, we propose a model that provides reliable strategies of each preprocessing and extraction. The foremost step concerned during this paper is obtaining EEG signals as input and generating corresponding brain map and applying ICA as pre-processor to induce filtered image. The LBP is used to extract pattern options from filtered image and the proposed PATCH MEAN ASSISTED deep learning (PMA-DL) are used for classifying Epileptical seizure. Here the input image is split into patches. Every patch is split into 2 layers "Convolutional layer " and "Pooling layer" then repetition the steps for whole image for generating test features and to extract applied mathematics options of the raw signal, like finding mean values and obtaining weighted mean for the image. All the features are combined and therefore the dimensions of the embedded feature vector are reduced by the principal component analysis (PCA). Finally, the least square support vector machine (LSSVM) classifier is employed to classify the seizure. The planned system is achieved accuracy 97%, Sensitivity 98.1%, and Specificity 99.9%, in classifying the patients which is 1% higher than the existing methods.

Keywords*— Convolutional Neural Network(CNN), epileptic seizure, EEG brain map, Least Square Support Vector Machine(LSSVM), Local Binary Pattern (LBP), Patch Mean Assisted-Deep Learning(PMA- DL), Principal Component Analysis(PCA).

I. INTRODUCTION

Epilepsy is a (neurological) condition in the central nervous system, it often lacks memory of seizures or periods and in which brain functions become erratic, causing strange actions and sensations. Anyone can produce epilepsy. It affects all races, origins and ages of both males and females. During a seizure, some individuals with epilepsy appear to be blind for a few seconds, while others regularly move their arms or legs. Symptoms of seizures can vary greatly. To diagnose epilepsy, at least two unprovoked seizures are usually expected. Drug therapy surgery may manage the majority of seizures. To regulate seizures, some individuals need permanent care but the seizures gradually go away for others. Epilepsy is a neurological condition. Because of an epileptic seizure, Occurring infrequently and unpredictably, automatic detection of seizures in EEG is badly needed. Some children with epilepsy get over this disorder. EEG is a widely used clinical technique for its identification. It is also considered an essential method for the diagnosis of epilepsy. This is the most common procedure used to diagnose epilepsy. In this experiment, electrodes with a paste-like material or cap are placed on a patient's scalp. The electrodes recording the seizure affected the electrical activity of the brain. It is common to have differences in the normal brain wave pattern of a patient with epilepsy. This EEG, record the seizure while patient awake or in asleep condition. It can help the doctor decide the kind of seizure by tracking the seizures. A time-consuming and laborious procedure that places a heavy burden on neurologists and affects their performance is the manual examination of EEG brain signals. Using some standard approaches to help neurologists diagnose seizure vs. non-seizure or normal are the binary epilepsy situations.

Automatic EEG recordings are essential to detect seizures [1]. In this procedure, we proposed Patch-Assisted Mean CNN to detect epileptic seizures automatically. Obviously, it is time-overwhelming and tedious and it is potential to get a prompt and proper designation of brain disease. Uncontrolled or repeated seizures may contribute to damage to the brain. Epilepsy also increases the risk of unexplained sudden death. It is possible to handle the situation effectively. Generally, seizures can be managed with medication. Seizures may be cut down or removed by two forms of brain surgery. One type, called resection, requires the removal of the part of the brain from which seizures occur. The surgeon may perform a disconnection when the region of the brain responsible for seizures is too vital or too large to remove. By making cuts in the brain, this means interrupting the nerve pathway. This prevents the transfer of seizures to other areas of the brain.

Patch Assisted Mean CNN EEG brain image is distributed into patches so that the surgeon can easily accurately identify the seizures affected area and provide treatment. The Flow of this proposed work is organized a follows: Section I portrays the introduction; Section II portrays the related works; Section III portrays the proposed methodology; Section IV portrays the Experimental results and discussion and finally conclusion is given in Section V.

II. RELATED WORKS

Epilepsy could also be a upset and for its detection, encephalography (EEG) could also be a unremarkably used clinical approach. Manual examination of encephalogram brain signals could also be a long and hard method, that puts serious burden on neurologists and affects their performance. Many automatic techniques are planned. It produces inaccurate results as well it shows less accuracy and time-consuming. Using LPB [16] for efficient retrieval of texture information for brain image without considering the center pixel of the brain image, CNGP and CTP image processing based feature extraction [11] in accounting center pixel value, time frequency analysis [15], Non-Linear and wavelet [10], Convolutional neural network with improvements in time-domain [7], temporal CNN [6], MLP for Epileptical classification, and deep CNN [3][4][12]. while using these techniques some features of brain image may get loss. To avoid features missing problem we use both image processing algorithm and deep learning techniques for efficient retrieval of features and this show more accuracy than the previously used algorithm.

Some brain image features may get loss while using these techniques. To avoid features missing problem, we used both image processing algorithm and deep learning techniques for

efficient retrieval of features. The proposed method achieves 1% better accuracy than the other epileptical seizure detection methods.

III. PROPOSED METHODOLOGY

This detection technique aims to spot whether or not the brain pictures having a epileptical seizure or not. In this section, we briefly discuss the data preparation strategies like import data, pre-processing techniques, feature extraction, optimization, classification, performance exploration. This projected methodology is worked below MATLAB atmosphere and also the flow of the projected work is given in Fig.1.

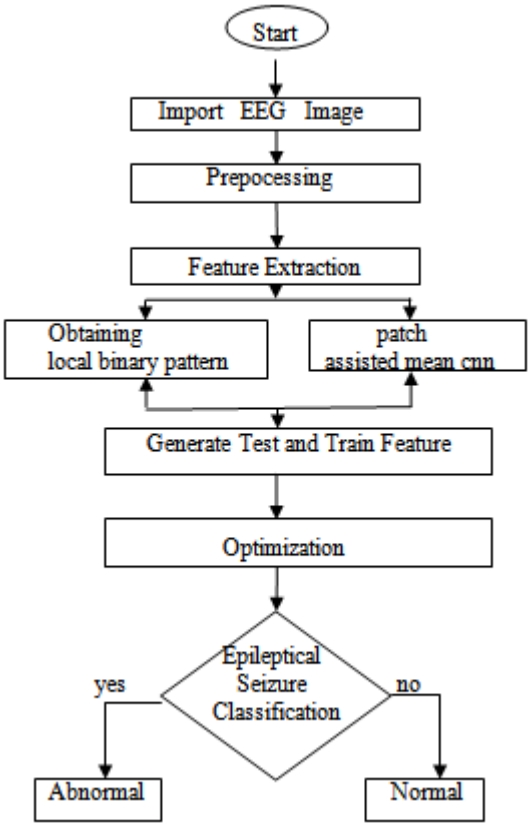


Fig 1. Work flow diagram of the New Detection method.

A. *Import Data:*

In this work, input data is EEG signals obtained from 100 affected and non affected persons. Further, these signals are used to generate brain map. These generated brain maps are used for further process.

B. *Preprocessing:*

In signal method, freelance component analysis (ICA) could also be a machine technique for separating a variable signal into additive sub parts. Typically often done by assumptive that the sub parts unit of measurement non-Gaussian signals that they are statistically freelance from each other. ICA could also be a special case of blind offer separation. It is a way to estimate original signals from determined signals that encompass mixed original signals and noise. BSS is additionally vital for brain signal analysis. a standard example application is that the "cocktail party problem" of listening in on one person's speech in an exceedingly rackety area.

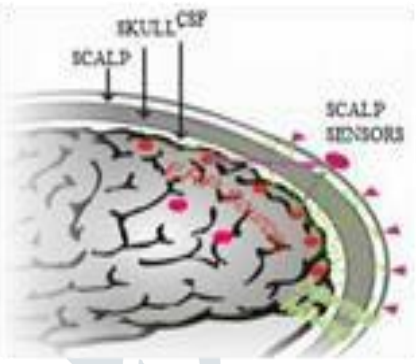
ICA performs a linear projection into independent components by using Eq.(1).

$$X = AS \quad (1)$$

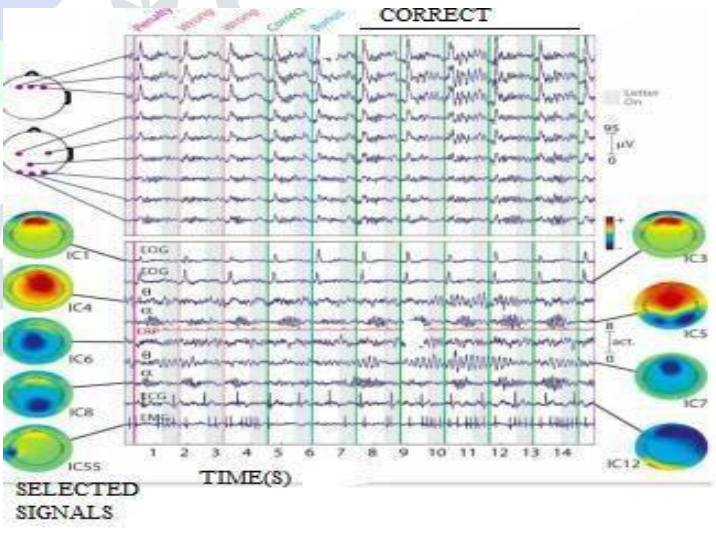
$$X_{nxN} = A_{nxp} \cdot S_{pxN}$$

Samples of statistically independent random variables

X = ICA mixture model
A = mixing matrix
S = source signals
p = number of components n number of variables
N = number of samples



(a)



(b)

Fig. 2.(a) fixing sensors on brain (b) The EEG waveform and the corresponding brain maps.

By using ICA method filtered brain image is obtained. It was used to extract independent components and then brain maps were formed using those independent components as illustrated in Fig. 2. (a) shows analyzing EEG and (b) shows ICA for EEG.

C. Feature Extraction:

Feature extraction is said to spatial property reduction. Once the input data to associate degree rule is simply large to be processed and it's suspected to be redundant, then it usually remodeled into a reduced set of options conjointly named a feature vector. Decisive a set of the initial options is called feature choice. The chosen options are expected to contain the relevant data from the input data, so as that the desired task is usually performed by mistreatment this reduced illustration instead of the whole initial information. Options are not solely the foremost necessary, however conjointly the foremost troublesome task from the classification method as they outline input data and classification quality. During this work image process rule LBP and patch aided mean CNN algorithms are applied to the brain maps to extract texture options for classification.

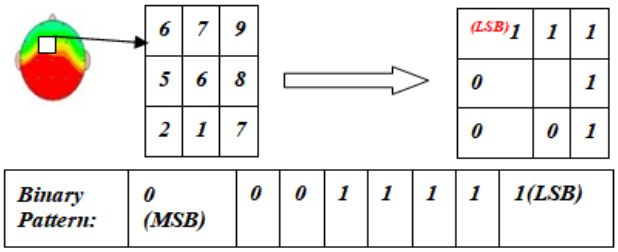
LOCAL BINARY PATTERN ALGORITHM:

The native binary pattern operator may well be a image operator that transforms a picture into associate array or image of variety labels describing small-scale look (textures) of the image. These labels directly or their statistics unit of measurement used for extra analysis. Each generated brain image has the precise dimension of 256x256. The local binary pattern steps is to first divide the examined window into cells (e.g.16x16 pixels for each cell). for every pixel in Associate in Nursing passing cell, compare the image part to each of its eight neighbors (on its left-top, left-middle, left-bottom, right-top, etc.). Right-handed or counter right-handed follows the pixels on a circle. Where the center pixels value is larger than the neighbor's value. Write "1". Otherwise, write "0" by exploitation (2). This offers associate in Nursing 8-digit binary vary (which is usually regenerate to decimal for convenience). Reckon the bar chart, over the cell, of the frequency of each "number" occurring (i.e., every combination of that pixels square measure smaller and that square measure bigger than the center). Optionally normalize the bar graph. Concatenate (normalized) histograms of all cells. This offers the feature vector for the window.

Formula/Expression:

$$LBP_{A,B} = \sum_{P=0}^{P=1} s(X-Y)2^P, \quad s(x) = \begin{cases} 1, & x>0 \\ 0, & x<0 \end{cases} \qquad \ldots(2)$$

Y is the grey worth of the central.
X is that the worth of its neighbors.
A is that the total range of concerned neighbors.
B is that the radius of the neighborhood.
s(x) is that the thresholding operate.



Binary Pattern:	0 (MSB)	0	0	1	1	1	1	1(LSB)

Code	$0x2^7$	$0x2^6$	$0x2^5$	$1x2^4$	$1x2^3$	$1x2^2$	$1x2^1$	$1x2^0$
	0	0	0	16	8	4	2	1

LBP:	1+2+4+8+16+0+0+0=21

Fig. 3. Illustration of LBP operation

Like this, we obtaining the LBP value for the 265x256 brain image as shown in Fig.3. LBP operator is used for measuring the texture, under some sure circumstance they miss the native structure as they do not contemplate the impact of the middle component. For further efficient approach we are using patch assisted mean CNN.

PROPOSED PMA- DL METHOD:

EEG brain Image has 256x256 pixels. This image is divided into 16x16 patches. Patches means group of pixels in an image. For example, if an image with 20*20 pixels. We can divide it into 1000 squares patches of size 2x2 pixels each. The patched block is further undergoing into the process called Convolutional layer and pooling layer.

Computing PML - DL Method:

1: The input for the algorithm is EEG map IMAGE.
2: The image is split into patches, like 16x16.
3: Each patch is undergoing the processes called "convolutional layer", "pooling layer"(max pooling).
4: Repeat step for every 16x16 patches.
5: Extract mean values of each patch and assign the weighted values of each patch.
6: Generate cells to store the feature values.

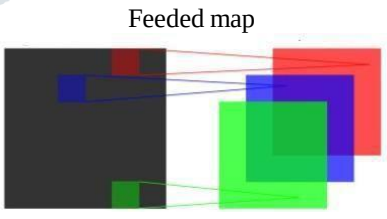


Fig. 4.Represent featured map.

Convolutional neural network summarize the presence of options in an input image. It is a multi-layer neural

network. It is comprised of one or extra Convolutional layers (often with a pooling layers) therefore followed by one or extra fully connected layers. Convolutional layer acts as a feature extractor that extracts options of the inputs like edges, corners, endpoints as portrayed in Fig.4.

Convolutional layers throughout a convolutional neural network systematically apply learned filters to input image thus on type feature maps that summarize the presence of those options at intervals the input. It record the precise position of options at intervals the input. This implies that little movements at intervals the position of the feature at intervals the input image will finish during a distinct feature map. This might happen with re-cropping, rotation, shifting, and different minor changes to the input image. To beat this limitation of the feature map pooling layer is value-added when the convolutional layer for ordering layers at intervals a convolutional neural network which can be continual one or further times throughout a given model. It operates upon each feature map one by one to create a current set of constant kind of pooled feature maps. The pooling operation size or filter is smaller than the scale of the feature map. Throughout this projected system most pooling (max pooling) is applied to calculate the biggest price in each patch of the feature map. It'll highlight the most present feature within the patch. The output after pooling layer would be a feature map containing the foremost distinguished features of the previous feature map. It extract the feature of image and convert it into lower dimension while not losing its characteristics. It collectively cut backs the resolution of the image that scale back the preciseness of the interpretation (shift and distortion) impact.

Pooling layer offer Associate in Nursing approach to down sampling feature maps by summarizing the presence of patches in feature map. Combining these obtained feature test feature get generated. The generated feature is further used for optimization.

D. Optimization:

PCA is that the effective improvement tool employed in this methodology. Since patterns in info are going to be arduous to hunt go in info of high dimension, where the luxurious of graphical illustration is not accessible. PCA is also a strong tool for analyzing info. Once the patterns unit found then we are going to compress the data that's by reducing the number of dimensions, whereas not heaps of loss of information. PCA transforms the initial reticulate variables into a replacement set of unrelated variables call Principal components. Advantage of victimization, PCA is deflate the number of variables or reduces property. PCA captures major (principal) variability gift at intervals the data set and ignores smaller variability. It helps find Eigen values and Eigen vectors.

Principle of PCA

It works on Linear projection technique to reduce the amount of variables. Transfer a bunch of correlate variables into a replacement set of unrelated variables. Map the information into a neighborhood of lower property. PCA rotates existing axes to new positions at intervals the house printed by original variable.

PCA may well be a strong variable mathematics tool for analyzing data and finding patterns in it. Mapping of data compression is in addition accomplishable exploitation PCA. PCA plots have to be compelled to be understood by looking at points relative to the origin.

Points that unit in similar directions or closed positions unit fully correlate. Points that unit on opposite sides of the origin unit negatively correlate. Points that unit far from the origin or plenty of perpendicular less correlate as given in Fig.5.

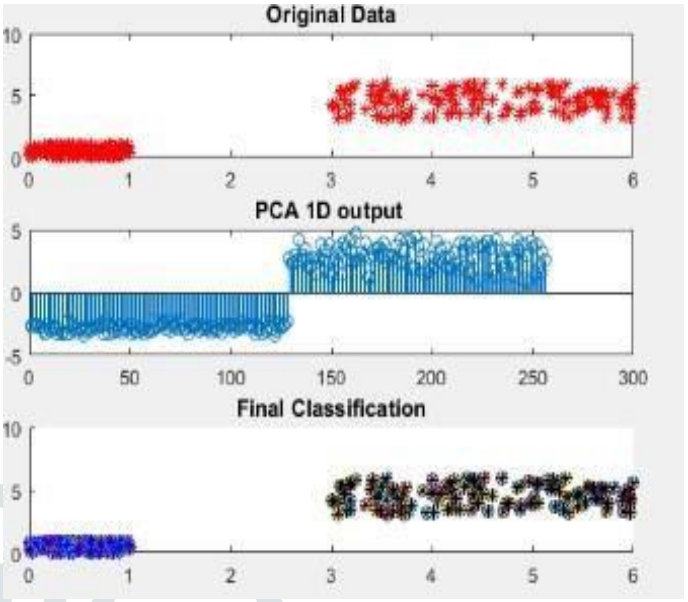


Fig. 5. PCA plotting with relative to origin

TABLE II. It shows how to calculate TP/FP/FN/TN.

Model predictions	Positive	Negative
Positive	True Positive/TP Number of observations positive = positive	False Positive/FP Number of observations positive = negative
Negative	False Negative/ FN Number of observations negative = positive	True Negative/TN Number of observations Negative = Negative

E. Classification:

The dataset comprises one hundred graph signals and a complete of ten brain maps are extracted from it. The extracted brain maps are split into 2 groups: Epileptical brain maps and non epiletical brain maps. In this work two labels are wont to determine the epileptical seizure. Classifier are wont to determine the patient whether he/she get affected or not by using test feature and train features. Classifier uses the generated map to spot the seizure. Already trained classifier like LSSVM is employed. LSSVM are a gaggle of connected supervised learning strategies that analyze knowledge and acknowledge patterns, and that are used for classification. The projected technique obtained associate economical accuracy rate by using LSSVM classifier. The retrieved brain maps from classifier output area unit displayed for the neurologists for diagnostic functions.

F. Performance:

The Detection performance is evaluated by three main applied mathematics measurements of specificity (SPE), accuracy (ACC) and sensitivity (SEN) is given in Eq.(3)-(5). Sensitivity is to take a look at positive out of total unhealthy. Specificity is live of true negative out of total healthy patient. Accuracy is to take a look at is its ability to differentiate the patient and healthy cases properly. To estimate the accuracy of a take a look at, we should continuously calculate the proportion of true negative and positive altogether evaluated cases. Mathematically, this could be declared as:

$$\text{Sensitivity} = TP/TP+FN \quad \ldots (3)$$
$$\text{Specificity} = TN/TN+FP \quad \ldots (4)$$
$$\text{Accuracy} = TP+TN/TP+TN+FP+FN \quad \ldots (5)$$

IV . EXPERIMENTAL RESULTS AND DISCUSSION

The analysis of potency of this planned methodology is evaluated victimization pysionet dataset. From experimental results, it's ascertained that the planned methodology achieved 1% additional accuracy than the existing LBP for pattern extraction neglecting center pixel, CNGP & CTP is for feature extraction by observing center pixel value and MLP to extract features for whole brain image as shown in Table III and in Fig. 6. Since the accurate feature extraction using Patch Assisted Mean CNN works effectively.

TABLE III. Differentiate of different epileptical detection methods with proposed method.

DETECTION METHODS	ACC	SEN	SPE
LBP	96	95.95	99.95
CNN	97.69	97.79	99.96
MLP	94	93.93	99.93
PROPOSED	98.48	98.16	99.97

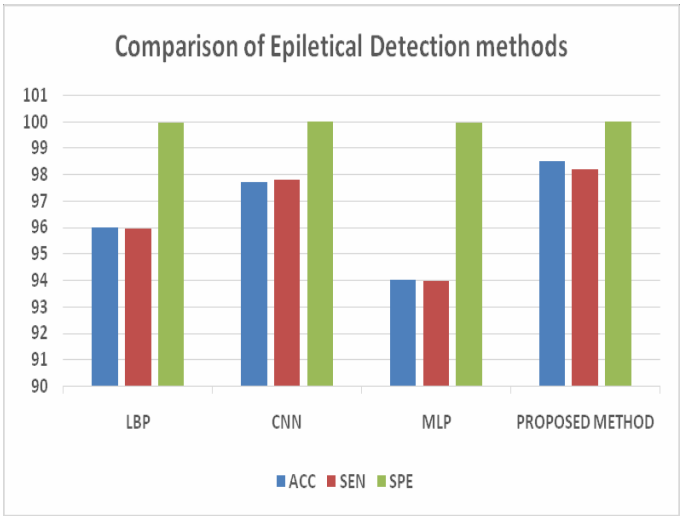


Fig. 6. It shows obtained accuracy, sensitivity, specificity values in percentage with existing methods.

V. CONCLUSION:

The main advantage of the algorithm are the ability of the algorithm to run robustly and noise effort reduced and also simplicity associated low process value guaranteeing real clinical application superb sensitivity and specificity similarly as an overall classification accuracy of 98%, Sensitivity 98.1%, and Specificity 99.9% in classifying the patients which is 1% higher than the existing methods. Therefore the proposed algorithm will meet the clinical requirements. In the near future this work are going to be extended by aggregation a lot of knowledge from epiletical diagnostic center for testing this model.

FUTURE WORK:

Currently, the brain disorder sightion strategies detect seizures when their incidence. In future, we'll investigate its quality for sleuthing seizures before their incidence, that may be a difficult downside.

REFERENCES:

[1] Ghassemi, A. Shoeibi, M. Rouhani, and H. Hosseini-Nejad, "Epileptic seizures detection in eeg signals using tqwt and ensemble learning," in 2019 9th International Conference on Computer and Knowledge Engineering (ICCKE). IEEE, 2019, pp. 403–408.

Kulaseharan, A. Aminpour, M. Ebrahimi, and E. Widjaja, "Identifying lesions in paediatric epilepsy using morphometric and textural

[2] analysis of magnetic resonance images," NeuroImage: Clinical, vol. 21,101663, 2019.

[3] R. Acharya, S. L. Oh, Y. Hagiwara, J. H. Tan, H. Adeli, and D. P. Subha, "Automated eeg-based screening of depression using deep convolutional neural network," Computer Methods and Programs in Biomedicine, vol. 161, pp. 103 – 113, 2018.

[4] Zuo, J. Wei, X. Li, C. Li, C. Zhao, Z. Ren, Y. Liang, X. Geng, C. Jiang, X. Yang et al., "Automated detection of high frequency oscillations in epilepsy based on a convolutional neural network," Frontiers in computational neuroscience, vol. 13, p. 6, 2019.

[5] Thomas, L. Comoretto, J. Jin, J. Dauwels, S. S. Cash, and M. B. Westover, "Eeg classification via convolutional neural network- based

interictal epileptic form event detection," in 2018 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC). IEEE, 2018, pp. 3148–3151.
[6] J. Zhang, H. Wu, W. Su, X. Wang, M. Yang, and J. Wu, "A new approach for classification of epilepsy eeg signals based on temporal convolutional neural networks," in 2018 11th International Symposium on Computational Intelligence and Design (ISCID), vol. 2. IEEE, 2018, pp. 80– 84.
[7] Wei, J. Zou, J. Zhang, and J. Xu, "Automatic epileptic eeg detection using convolutional neural network with improvements in time- domain," Biomedical Signal Processing and Control, vol. 53, p. 101551, 2019.
[8] Wen and Z. Zhang, "Deep convolution neural network and autoencoders-based unsupervised feature learning of eeg signals," IEEE Access, vol. 6, pp. 25 399–25 410, 2018.
[9] PL.Chithra, G.Dheepa, An analysis of segmenting and classifying tumor regions in MRI images using CNN. International journal of pure and applied mathematics, 118, 24, 1-12,2018.
[10] "Application Of Non-Linear And Wavelet Based Features For The Automated Identification Of Epileptic EEG Signals". International Journal of Neural Systems Vol. 22, No. 02, 1250002 (2012).
[11] S. N. Jothiraj, T.G. Selvaraj, "Classification of EEG signals for detection of epileptic seizure activities based on feature extraction from brain maps using image processing algorithms".IET,vol. 12 2018.
[12] Acharya et al., 2018 U.R. Acharya, S.L. Oh, Y. Hagiwara, J.H. Tan, H. Adeli Deep convolutional neural network for the automated detection and diagnosis of seizure using EEG signals Comput. Biol. Med., 100 (2018), pp. 270-278.
[13] Cun Y. L. (1995). Convolutional networks for images, speech, and time series, in Handbook of Brain Theory & Neural Networks, ed Arbid A., editor. (Cambridge, MA: MIT Press).
[14] T. S. Kumar, V. Kanhangad and R. B. Pachori, "Classification of seizure and seizure-free EEG signals using local binary patterns", *Biomed. Signal Process.* vol. 15, pp. 33-40, 2015.
[15] A. T. Tzallas, M. G. Tsipouras and D. I. Fotiadis, "Epileptic seizure detection in EEGs using time–frequency analysis", *IEEE Trans. Inf. Technol. Biomed.*, vol. 13, no. 5, pp. 703-710, Sep. 2009.
[16] Digital image classification algorithm based on LBP and LSSVM Gen-shan ZHANG et al., Chinese Journal of Liquid Crystals and Displays, 2020.