

Classification using fundus image of eye by CNN method and self-sufficient glaucoma detection using IOT

S. Vanakovarayan^{a,*}, R. Sarath Kumar^b, S. Chinnapparaj^c, S. Satheesh Kumar^d

^a Department of Computer Science and Engineering, Mailam Engineering College, Mailam, Tamilnadu, India

^b Department of ECE, Sri Krishna College of Engineering and Technology, Coimbatore, Tamilnadu, India

^c Department of ECE, Hindusthan Institute of Technology, Coimbatore, Tamilnadu, India

^d Department of ECE, KPR Institute of Engineering and Technology, Coimbatore, Tamilnadu, India

ARTICLE INFO

Article history:

Received 14 August 2020

Accepted 25 August 2020

Available online 1 October 2020

Keywords:

Optic cup

Pre-processing

Fractal dimension perimeter method

Digital image processing

Fundus images

Diabetic retinopathy

CNN technique

ABSTRACT

Glaucoma is a turmoil where serious harm to the optic nerve prompts vision misfortune. Glaucoma distinguishing proof includes the estimation of the shape and size of the optic cup. Because of the interweavement of the optic cup with veins, the optic cup division is somewhat dull errand. Pre-preparing followed by division is utilized for optic cup division which is additionally handled to discover its measurement. In view of the reality the fractal measurement is utilized to discover the element of unpredictable articles, a novel methodology is proposed for glaucoma location utilizing the edge strategy for fractal examination. The Normal and glaucoma absconded picture is arranged and recognized by computerized picture preparing by CNN technique and executed utilizing IOT.

© 2020 Elsevier Ltd. All rights reserved.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Newer Trends and Innovation in Mechanical Engineering: Materials Science.

1. Introduction

Diabetes has gotten one of the primary difficulties for our human wellbeing. As indicated by the estimation of the International Diabetes Federation, the quantity of diabetic patients will ascend to 592 million by 2035. As a typical inconvenience of diabetes, diabetic retinopathy (DR) can cause extreme vision misfortune and visual impairment in this populace. An ordinary procedure received by most strategies is to identify explicit DR injuries for the entire retinal picture. Regulated learning strategies are generally applied to group the portioned applicants or picture patches into typical and anomalous classes. In result, it blocks the arrangement of bigger preparing datasets, from which this information driven techniques could learn better to handle diverse DR circumstances. So as to spare the comment cost and make increasingly retinal pictures accessible for learning, and DR sore. The improvement of the PC based techniques that would empower the high likelihood acknowledgment of pre-diabetic or diabetic

conditions can be productive help to the dynamic in medicinal services Tables 1-3.

AI is the region of man-made brainpower that utilizes factual investigations and is perceived to be a promising zone dependent on the given dataset of diabetes can help inpatient grouping or likelihood forecast. The principle quality is the capacity of the calculations to gain from information and to utilize that information for later forecasts and choices. There are a few AI and factual displaying approaches that so far have been associated with different parts of tackling the issue.

2. Existing system

Assessment of veins in the eye is significant tooling distinguishing different eye ailments in the clinical field. This assignment gets troublesome because of the nearness of brilliant and dull injuries in fundus pictures. Inverse to the focal point is the fundus which is the inside surface of eye and incorporates the retina, optic circle, macula, back post and fovea. The veins in the fundus picture ought to be divided and broke down glaucoma and diabetic retinopathy. These infections go to prompt visual impairment. Visual impairment is a developing issue everywhere throughout the world.

* Corresponding author.

E-mail address: vanakovarayancse@mailamengg.com (S. Vanakovarayan).

Table 1
GLCM Feature Extraction of Normal Patient.

No of Patients	Energy	Contrast	Homogeneity	Entropy	Correlation
1	0.0201	25.6419	0.5667	7.3903	0.9975
2	0.0144	28.5667	0.5738	7.3954	0.9973
3	0.0300	21.8932	0.5995	7.1505	0.9978
4	0.0184	28.1873	0.5768	7.5006	0.9972
5	0.0323	28.8840	0.5857	7.2327	0.9970
6	0.0211	23.4808	0.5960	7.3412	0.9977
7	0.0252	30.5018	0.5446	7.5043	0.9969
Average	0.02307	26.7365	0.5775	7.3592	0.9973

Table 2
GLCM Feature Extraction of Affected Patient.

No. ofPatients	Energy	Contrast	Homogeneity	Entropy	Correlation
1	0.0298	35.1338	0.5538	7.2010	0.9965
2	0.0184	35.8852	0.5410	7.6938	0.9965
3	0.0133	46.1941	0.5330	7.7584	0.9956
4	0.0322	37.3632	0.5620	7.2481	0.9962
5	0.0220	44.3980	0.5173	7.6479	0.9956
6	0.0225	64.8641	0.4851	7.6348	0.9935
7	0.0191	33.1517	0.5345	7.6046	0.9968
8	0.0195	82.8278	0.4959	7.6710	0.9919
Average	0.0221	47.4772	0.5278	7.55745	0.9953

Table 3
Output performance metrics.

Parameters	Existing System Classifier (SVM)	Proposed SystemClassifier (CNN)
TP	50	75
FP	8	3
FN	10	5

3. Proposed system

In this undertaking Glaucoma is a quiet cheat of sight. Detail of eye vision utilized for picture handling utilizes picture preprocessing, highlight extraction, include determination, CNN is appeared in Fig. 1.

Procedures and datasets utilized for testing and preparing purposes. Glaucoma recognizable proof includes the estimation of the shape and size of the optic cup. The way that the fractal measure-

ment is utilized to discover the element of sporadic articles, a novel methodology is proposed for glaucoma recognition utilizing the border technique for fractal investigation. The glaucoma is distinguished by methods for CNN calculations. The ailment is identified, at that point the distinguished data sends to the microcontroller. In the event that malady identified, at that point the information will be sent to a microcontroller and afterward the controller will refresh tolerant data on by utilizing IoT. On the off chance that a malady distinguished, at that point the microcontroller will show the information in LCD.

Equipment Requirements

- Microcontroller ATmega328(Adriano),
- LCD

3.1. Software requirements

- Operating system: Windows XP 7/8/10
- Coding Language: C Language
- Tool: MATLAB R2018a- Image processing Toolbox

3.1.1. Pre-Processing

Information mining is a significant procedure of the pre-preparing. There is an irrelevant excess data present and questionable information and furthermore the information revelation during the preparation stage is progressively troublesome. Information separating step can take a lot of handling time. Information pre-handling incorporates highlights, for example, include extraction, cleaning, case determination, standardization, change and choice, and so on [1-7].

3.1.2. Image pre-processing

The image pre-processing describes common image pre-processing operations, illuminating the differences and commonality among these pre-processing steps, which can be applied before the feature description [8-13].

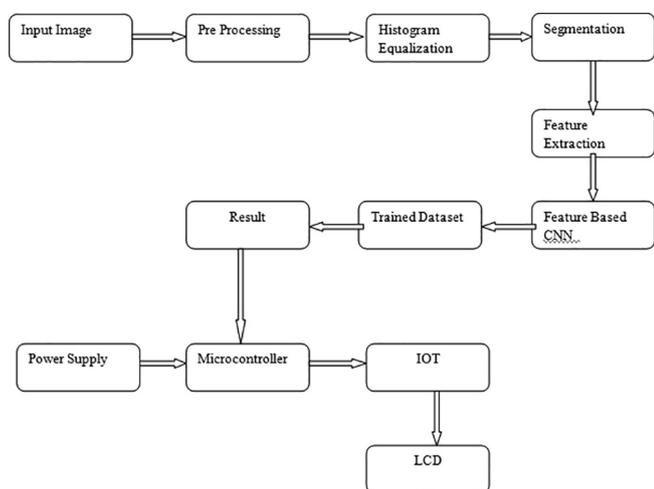


Fig. 1. Block Diagram for Proposed System.

3.1.3. Image segmentation

Isolating a picture into numerous sections are picture segmentation. Image division is utilized to find and discover limits. Each pixel in the locale is like some trademark or figured property, for example, shading, surface or force. Contiguous areas are progressively unique as for similar attributes. The example of the picture is found by interfacing between these two ideas of a picture and any normality in the picture can be utilized to pack and its length is processed as follows [14-19].

3.1.4. Median filter

The mean channel is essentially utilized for 'expelling clamor from a picture and it is a non-direct advanced channel and furthermore keeps edge safeguarded while the commotion is evacuated. The possibility of this channel is to check through the section to passage by supplanting each passage by middle of neighboring passage. The example of neighbor section is called window, which shows passage to passage over a whole sign [20-22].

3.1.5. Histogram Equalization

It is a PC picture preparing strategy used to improve differentiate in pictures. It achieves this by successfully spreading out the most continuous power esteems that are surpassing out the force scope of the pictures.

3.1.6. Otsu's method

Otsu's strategy found by Nobuyuki Otsu which is a PC vision and picture preparing method used to naturally play out a bunching-based picture limit or the decrease of the dark level picture to a double such as (0 and 1) esteem.

3.1.7. Gray-level co-occurrence matrix (GLCM)

The Gray-Level Co-occurrence Matrix (GLCM) utilized in picture examination process for applications, particularly in the biomedical field dependent on surface-based surface highlights presented by Haralick. At the point when a bunch shade and group unmistakable quality are generally high, at that point the picture isn't symmetric as for its surface qualities. It is a most significant second request old style strategy for surface examination [23-27].

4. CNN method

A Convolution Neural Network is a Learning calculation that can take an information picture and dole out significance to different perspectives in the picture and have the option to separate one from the other. The pre-preparing required in Convolution arrange is a lot of lower when contrasted with other order calculations. While, in crude techniques channels are hand-designed, with enough preparing, Convolution Network get familiar with these channels. is similar to that the Human Brain and was propelled by the association of the Visual Cortex. Individual neurons react to improvements just in a confined area of the visual field known as the responsive Field.

5. Simulation output

5.1. Input image

The yield screen shows the dim scale picture in Fig. 2, the hued picture is changed over to dark scale picture to decrease the time taken to process the capacity.

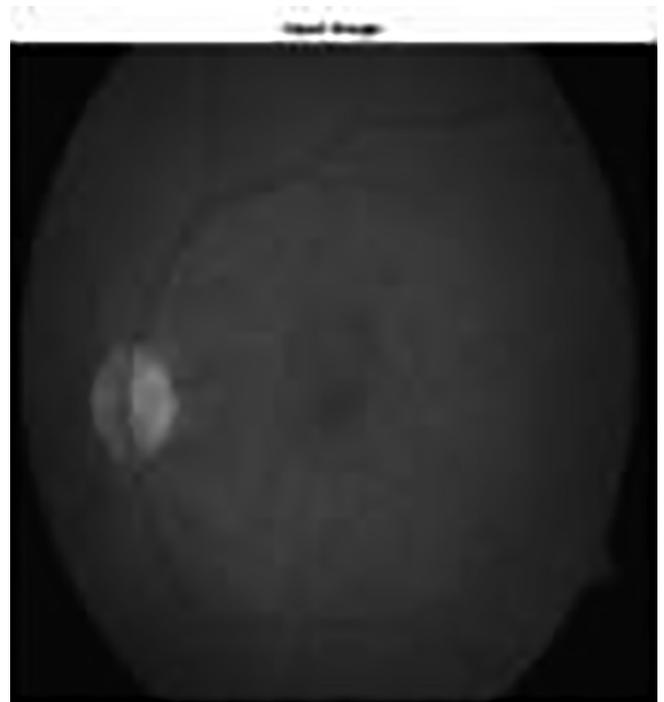


Fig. 2. Input Image.

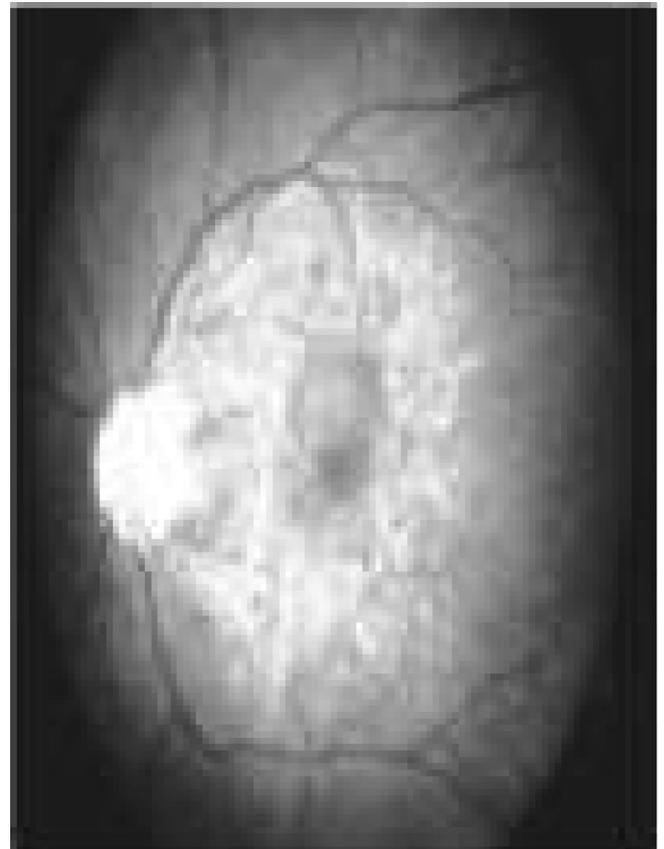


Fig. 3. Histogram Equalization.

5.2. Histogram Equalization

The histogram evening out is utilized to expel the clamor present in the changed over picture. The middle channel is utilized

here to expel the commotion, the clamor channel can be of any sort. The histogram evening out is likewise used to resize the picture into 512*512 pixels in Fig. 3.

5.3. Defected region of input image

In this capacity, the darker regions are being zoomed to find the absconded part in the retinal picture appeared in Fig. 4.

5.4. Extracted Blood vessels

As appeared in Fig. 5 the veins are naturally identified utilizing the default vessel extraction work present in the MATLAB.

5.5. Segmented output

The shading transformation happens in this kind of procedure, the white shading is changed to dark and the dark is changed over to white as in Fig. 6. This idea works with parallel rationale 0 and 1 Figs. 7-11.



Fig. 5. Blood Vessel.



Fig. 4. Defected district.



Fig. 6. Segmented Image.



Fig. 7. Eroded Region.

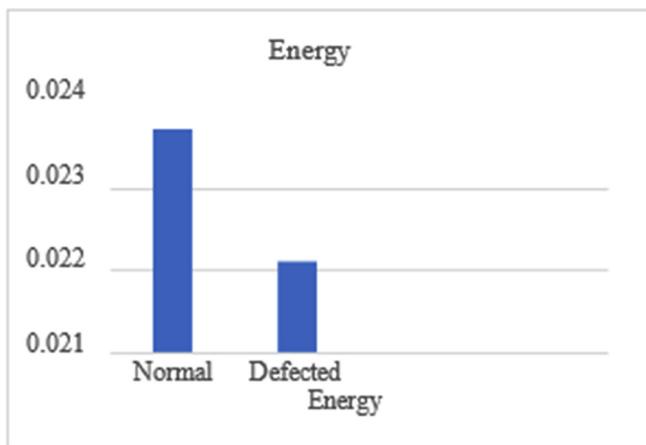


Fig. 8. Energy Comparison Graph.

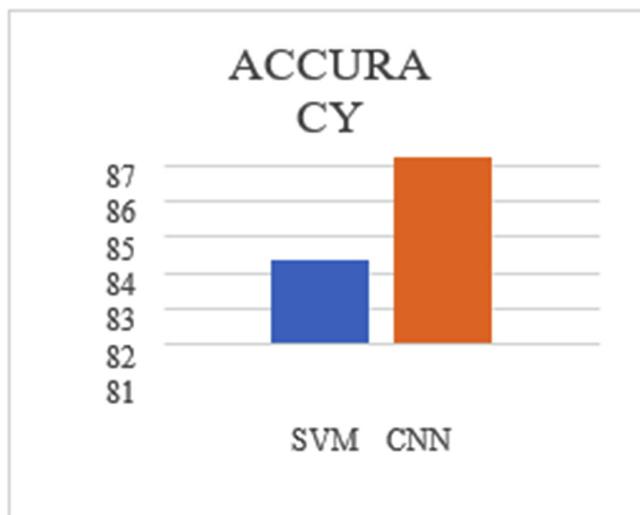


Fig. 11. Accuracy Graph.

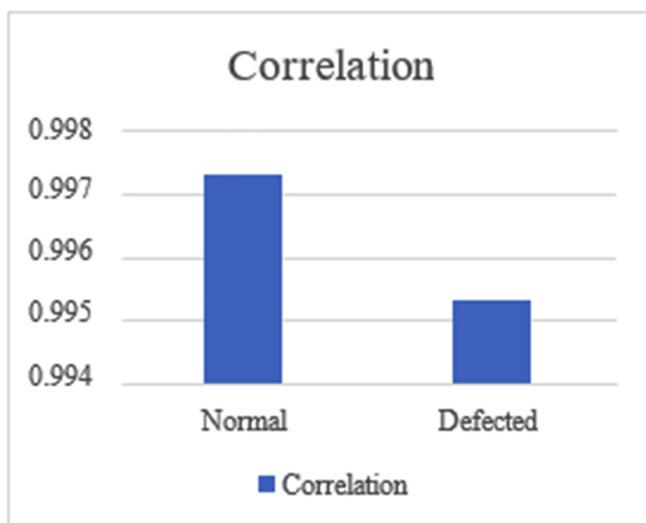


Fig. 9. Correlation Comparison Graph.

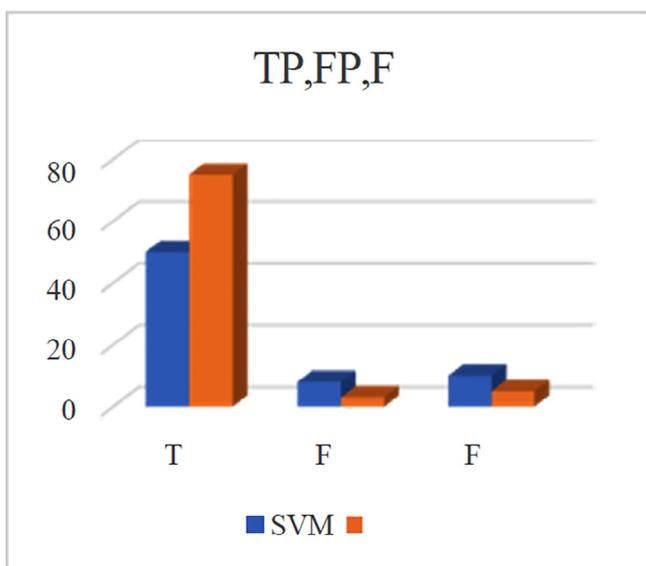


Fig. 10. TP, FP, FN Comparison Graph.

Table 4
Output Performance Metrics.

Parameters	SVM	CNN
Accuracy	83.33	86.21
Precision	93.75	96.15

5.6. Eroded region output

Widening is utilized in morphological technique. It is produced for parallel pictures, it has been extended first to grayscale picture, and afterward to finish cross sections.

5.7. GLCM feature extraction of normal patient

GLCM feature extraction glaucoma affected patients

6. Energy comparison graph

The energy value of normal person is 0.0235 The energy value of defected person is 0.022

7. Correlation comparison graph

Output performance metrics

8. Performance analysis

The performance of CNN output is analysed by 2 metrics as shown in Table 4.

- (i) Accuracy
- (ii) Precision

The accuracy can be defined as the percentage of correctly classified instances $(TP + TN) / (TP + TN + FP + FN)$.

9. Conclusion

In this paper we got exactness as 86.20% and accuracy as 96.15% with profound MIL technique for DR identification by taking the correlative focal points from MIL and profound learning just the

picture level explanation is expected to accomplish both location of DR pictures and DR injuries, in the meantime highlights and classifiers are mutually.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] Murali. D, Prasanna. S, Mathavan. V, Priyaradhikadevi. T. Journal of Critical Review Vol 7 Issue 16
- [2] S. A. SivaKumar, R. Naveen, D. Dhabliya et al., Materials Today: Proceedings 37 (2021) 1442–144.
- [3] B. Maruthi Shankar, S. A. Sivakumar, B. Vidhya et al., Materials Today: Proceedings 37 (2021) 1445–1448.
- [4] Dr.S.A.Sivakumar, Dr.S.Karthikeyan, Ms.M.Benedict Tephila, Dr.R.Senthil Ganes, Mr.R.Sarath Kumar, Dr.B.Maruthi Shankar, IJAST, vol. 29, no. 8s, pp. 2254 - 2260, May 2020.
- [5] T. Sathish, Dinesh Kumar Singaravelu, Journal of Scientific and Industrial Research, NISCAIR Publisher 79 (6) (2020) 547–551.
- [6] T. Sathish, Dinesh Kumar Singaravelu, Journal of Scientific and Industrial Research, NISCAIR Publisher 79 (5) (2020) 449–452.
- [7] T. Sathish, S. Karthick, Journal of Materials Research and Technology, Elsevier Publisher 9 (3) (2020) 3481–3487.
- [8] Thanikodi Sathish , Singaravelu Dinesh Kumar , Devarajan Chandramohan , Venkatraman Vijayan, Rathinavelu Venkatesh. Thermal Science, Vinca Institute of Nuclear Sciences, Vol. 24, Issue 1B, pp. 575–581.
- [9] Krishnaswamy Haribabu, Muthukrishnan Sivaprakash , Thanikodi Sathish , Arockiaraj Godwin Antony, Venkatraman Vijayan. Thermal Science, Vinca Institute of Nuclear Sciences, Vol. 24, Issue 1B, pp. 495–498.
- [10] Muthukrishnan Sivaprakash, Krishnaswamy Haribabu, Thanikodi Sathish, Sundaresan Dinesh, Venkatraman Vijayan, Thermal Science, Vinca Institute of Nuclear Sciences 24 (1B) (2020) 499–503.
- [11] T. Sathish, Journal of Materials Research and Technology, Elsevier Publisher 8 (5) (2019) 4354–4363.
- [12] T. Sathish, Transactions of the Canadian Society for Mechanical Engineering 43 (04) (2019) 509–514.
- [13] T. Sathish, Transactions of the Canadian Society for Mechanical Engineering 43 (04) (2019) 551–559.
- [14] T. Sathish, J. New Mater. Electrochem. Syst. 22 (1) (2019, 2019,) 5–9.
- [15] T. Sathish, International Journal of Ambient Energy, Taylor and Francis Publishers, Accepted (2019), <https://doi.org/10.1080/01430750.2019.1608861>.
- [16] T. Sathish, J. Jayaprakash, P.V. Senthil, R. Saravanan, FME Transactions 45 (1) (2017) 172–180.
- [17] T. Sathish, J. New Mater. Electrochem. Syst. 20 (2017) 161–167.
- [18] T. Sathish, Journal of Applied Fluid Mechanics 10 (24) (2017) 41–50.
- [19] T. Sathish, Journal of Applied Fluid Mechanics 11 (2018) 39–44.
- [20] T. Sathish, J. New Mater. Electrochem. Syst. 21 (3) (2018) 179–185.
- [21] T. Sathish, Materials Today Proceedings, Elsevier Publisher 05 (6) (2018) 14416–14422.
- [22] T. Sathish, Lecture notes on Mechanical Engineering – Springer, Accepted (2018), https://doi.org/10.1007/978-981-13-6374-0_45.
- [23] T. Sathish, International Journal of Ambient Energy, Taylor and Francis Publishers 41 (07) (2020) 1–6.
- [24] T. Sathish, Materials Today Proceedings, Elsevier Publisher 05 (6) (2018) 14448–14457.
- [25] T. Sathish, Materials Today Proceedings, Elsevier Publisher 05 (6) (2018) 14545–14552.
- [26] T. Sathish, S. Dinesh Kumar, K. Muthukumar, S. Karthick, Materials Today Proceedings, Elsevier Publisher 21 (1) (2020) 847–856.
- [27] Dr. T.PriyaRadhikaDevi. "Journal of Critical Review Vol 7 Issue 16.

Further Reading

- [1] E. Dervisevic, S. Pavljasec, A. Dervisevic, S. Kasumovic, "MedArch 70 (2016) 203–207.
- [2] H.A. Quigley, A.T. Broman, British. Journal of Ophthalmology 90 (2006) 262–267.
- [3] M.C. Leskea, A. Heijl, L. Hyman, B. Bengtsson, E. Komaroff, Current Opinion in Ophthalmology 15 (2004) 102–106.
- [4] W. Chan, Y., Hui, et al., Digest of the World, Core Medical Journals (2006).
- [5] M.A. Fernandez-Granero, A. Sarmiento, D., Sanchez-Morillo, et al. Journal of Healthcare, Engineering (2017, 2017,) 1–14.
- [6] M.H. Tan , Y. Sun and S.H. Ong et al. IEEE International Symposium on Biomedical Imaging, 2013.
- [7] S. Vernon, Practitioner 239 (1995) 257–260.
- [8] Nimitha N, Arun C. International Journal of Advanced Science and Technology Vol. 29, No. 4s, (2020), pp. 2128 - 2141 March 2020 (Scopus , IF= 0.41) on 24.03.2020.
- [9] Nimitha N, Poovizhi S. International journal for Research in Applied Science and Engineering Technology" (IJRASET) ISSN :2321-9653, Vol.4, Issue 10 (October 2016), PP 293-298
- [10] Nimitha N., Santhosh Kumar V., Steffin Franklin, Vignesh M., International Journal Of Applied Engineering Research, Vol 10(68), pp 361-364, July 2015.
- [11] Nimitha N., Ranjitha R., Santhosh Kumar V, Steffin Franklin., International Journal for Research In Applied Science and Engineering
- [12] Mathavan. V, Thulasidass. S, Vanakvarayan. S, Priyaradhikadevi. T. Journal of Critical Review Vol 7 Issue 16