IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Impact Factor: 6.252

Volume 2, Issue 3, May 2022

Diabetic Retinopathy Detection using Convolutional Neural Network

Rajesh K[1], Santhanam A[2], Sridhar M[3], Dr. J. Mohan[4]

Students, Department of Electronics and Communication Engineering[1,2,3]

Professor, Department of Electronics and Communication Engineering[4]

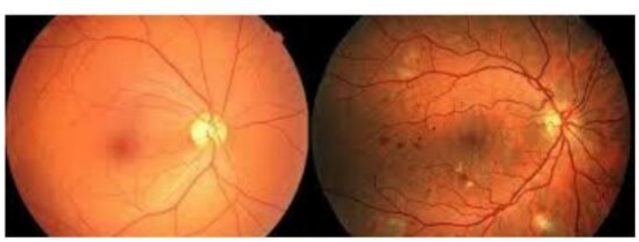
SRM Valliammai Engineering College, Kattankulathur, Tamil Nadu, India

Abstract: *Diabetes Mellitus, commonly known as Diabetes, is a caused due to high range of sugar in the human body. After a period of time diabetes will lead to a deficiency in eye called as Diabetes Retinopathy. The major symptoms of this disorder are bulging of blood vessels, small lesions and other eye related eyes. Diabetic Retinopathy is a complication that affect the eye due to the result of high blood glucose called diabetes. It can cause vision loss and in severe condition can lead to complete blindness. Early symptoms of diabetic retinopathy include blurred vision, darker areas of vision, eye floaters and difficulty in perceiving colors. Proper detection of diabetic retinopathy in early stage is extremely important to prevent complete blindness. Of an estimated 285 million people with diabetes mellitus worldwide, approximately one third have signs of diabetic retinopathy. The idea of our project is to analyze the severity level of the diabetes retinopathy using three different training methods. Deep learning plays a major role in the project. Proposed Model has been trained with three types, back propagation NN, DNN (Deep Neural Network) and CNN (Convolutional Neural Network).*

Keywords: Deep learning, Diabetic Retinopathy, Convolutional Neural Networks, Input, the human eye, classification, GUI.

I. Introduction

Diabetes is one of the most dreadful diseases of the world. Most of the aged people are getting affected by diabetes mellitus. The rise of sugar content in the body leads to many dreadful disorders. It also decreases the natural strength of the body. The other diseases caused due to the diabetes are severe. One such disorder caused by diabetes mellitus is called as Diabetic Retinopathy. The high sugar level leads to diabetic retinopathy. It is a disorder where the eye sight reduces stage by stage and at one stage the entire eye sight goes off. Diabetic retinopathy is an eye condition that occurs due to diabetes. It can arise as a result of the high blood sugar levels that diabetes causes. Over time, having too much sugar in the blood can damage blood vessels throughout the body, including in the retina. The retina is the membrane covering the back of the eye. It detects light and sends signals to the brain through the optic nerve. If sugar blocks the tiny blood vessels that go into the retina, it can cause them to leak or bleed. The eye may then grow new blood vessels that are 2 weaker and leak or bleed more easily. If the eye starts to grow new blood vessels, this is known as proliferative diabetic retinopathy, which experts consider a more advanced stage. The early stage is known as non-proliferative diabetic retinopathy. The eye may accumulate fluid during long periods of high blood sugar. This fluid accumulation changes the shape and curve of the lens, causing changes in vision. Once a person gets their blood sugar levels under control, the lens will usually return to its original shape, and vision will improve.



II. Literature Review

The diabetic retinopathy concerns not only the technical aspects such as image processing and machine learnings,but also the non-technical aspects such as what features to extract, and so on.

[1] Aryan Kokane, Gourhari Sharma, Akash Raina, Shubham Narole, Prof. Pramila M. Chawan, "Detection of Diabetic Retinopathy using Machine Learning" in International Research Journal of Engineering and Technology (IRJET), 2020.

[2] Wejdan L.Alyoubi, Wafaa M.Shalash, Maysoon F.Abulkhair, "Diabetic retinopathy detection through deep learning techniques: A review" in Informatics in Medicine Unlocked, 2020.

[3] Yung-Hui Li , Nai-Ning Yeh, Shih-Jen Chen and Yu-Chien Chung, "ComputerAssisted Diagnosis for Diabetic Retinopathy Based on Fundus Images Using Deep Convolutional Neural Network" in Mobile information systems, 2019.

[4] Suvajit Dutta, Bonthala CS Manideep, Syed Muzamil Basha, Ronnie D. Caytiles and N. Ch. S. N. Iyengar, "Classification of Diabetic Retinopathy Images by Using Deep Learning Models" in International Journal of Grid and Distributed Computing, 2018.

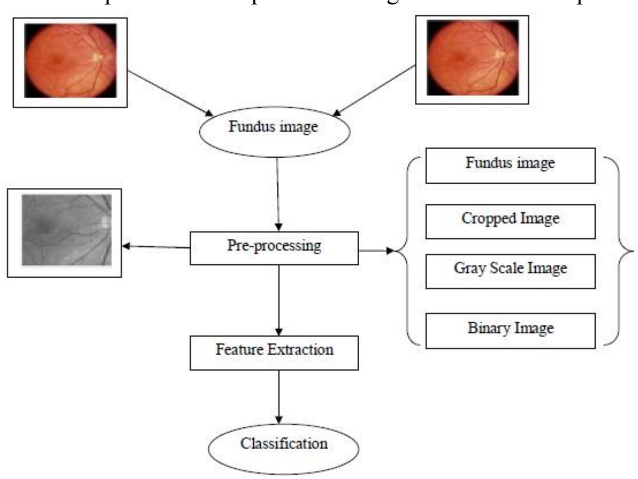
III. Proposed System

The proposed system is based on Convolutional Neural Networks, which make them fast and less prone to lags. The accuracy of the models are comparatively high around 73% which makes them reliable for real-time implementation. The proposed system is completely power efficient and also cost efficient and also maintenance is easy.

Retinal detachment. The abnormal blood vessels associated with diabetic retinopathy stimulate the growth of scar tissue, which can pull the retina away from the back of the eye. This may cause spots floating in your vision, flashes of light or severe vision loss.

3.1 Advantages of Proposed System

- The proposed system is using a CNN, so its make fast.
- The proposed system is more accuracy better than existing system.
- The proposed system is cost efficient manner.
- The proposed system is developed from the updated ML algorithms so its simple and easy.



IV. Methodology

Convolutional Neural Network is an algorithm of Deep Learning. That is used for Image Recognition and in Natural Language Processing. Convolutional Neural Network (CNN) takes an image to identify its features and predict it. It captures the spatial and temporal dependencies of the image. Each CNN layer learns filters of increasing complexity. The first layers learn basic feature detection filters like edges, corners. The middle layer learns filters that detect parts of objects. The last layers have higher representations they learn to recognize full objects in different shapes and positions. Suppose, when you see some image of a Dog, your brain focuses on certain features of the dog to identify. These features may be the dog's ears, eyes, or it may be anything else. Based on these features your brain gives you a signal that this is a dog. Similarly, Convolutional Neural Network processes the image and identifies it based on certain features. Convolutional Neural Network is gaining so much popularity over artificial neural networks. Steps in Convolutional Neural Network In a Convolutional Neural Network, there are basically the following steps

1. Convolution Operation.
2. ReLU Layer.
3. Pooling.
4. Flattening.
5. Full Connection.

Generally, a convolutional neural network architecture generally has several components:

- **A convolution layer** - you can think of this layer as "what relevant features are we picking up in an image?" In a convolutional neural network, we have multiple convolutional layers that extract low to high-level features depending on what specific layer we are focusing on. To give an (over-simplified) intuition, earlier convolutional layers pick up lower-level features (i.e. like lines and edges) while later convolutional layers pick up higher-level features based on inputs from lower-level features (i.e. shapes, structures) - analogous to how vision works in the human brain.
- **A pooling layer** - convolutional neural networks are typically used for image classification. However, images are high-dimensional data - so we would prefer to reduce the dimensionality to minimize the possibility of overfitting. Pooling essentially reduces the spatial dimensions of the image based on certain mathematical operations such as average or max-pooling (there's a nice graphic here). We generally incorporate pooling since it
    - generally, acts as a noise suppressant
    - makes it invariant to translation movement for image classification and
    - helps capture essential structural features of the represented images without being bogged down by the fine details.
- **Fully-connected layer** - You can think of a series of convolution and pooling operations as dimensionality reduction steps prior to passing this information over to the fully connected (Dense) layer. Essentially, what the fully connected layer does is that it takes the "compressed" representation of the image and it tries to fit a basic NN (multi-layer perceptron) when doing classification.

The change in paradigm that the usage of NNs encompasses is a very important one. Prior to the usage of NNs in image classification, the practitioner had to use explicitly coded algorithms for detecting features. This was a job that often involved a lot of work. Machine Learning was not used throughout the whole system, only the last layer of the system, the classifier, had a capacity to learn and adapt itself to the specific problem. NNs, and especially CNNs, dramatically change that. CNNs extract features from images and learn how to do it. The practitioner doesn't need to craft complicated hard coded algorithms to extract those features. Since the introduction of the first CNNs in 2012, all the winning teams for the classification task have used different types of CNNs. CNNs systems now clearly outperform other image classification systems such as the ones described. State of the art CNNs have even crossed the boundary of what is considered to be the error rate for human beings in image classification tasks. Ever since it's introduction in 2012, CNNs have been making steady progress in decreasing the error rate in both tasks. This is due to the introduction of new strategies that further improve the convergence and training speed of CNNs. CNNs are a particular kind of NNs that give their name to the fact that they make extensive use of Convolutional Layers.

Convolutional Layers consist of a learnable filter of fixed size (kernel) to be applied to images. The name comes from the fact that at each forward pass, the learned filter is convolved with the image resulting on a 2-dimentional map. Another type of layer widely used in CNNs are the pooling layers. These layers perform a type of down-sampling on the input signal. There are various types of Pooling layers, max-pooling being the most common. ReLUs or Rectified Linear Units, are also widely used in CNNs. ReLUs are units that apply a function similar to Equation 2.1. There are often alternatives for these types of units, Equation 2.2 and 2.3 show two of them.

$$\text{ReLU} : f(x) = \max(0, x) \qquad (2.1)$$

$$\text{Tanh} : f(x) = \tanh(x) \qquad (2.2)$$

$$\text{Sigm} : f(x) = (1+e^{-x})^{-1} \qquad (2.3)$$

Fully Connected Layers are used too, as in more standard NNs. These layers consist of an array of neurons, each of which is connected to every single output of the previous layer. Loss Layers are typically used at the end of the CNN to figure out the penalty for a given output and to provide feedback used by the CNN to learn. In addition to these more standard set of layers, modern CNNs make use of a very extensive set of techniques and strategies that greatly enhance their performance. Dropout is one of such techniques. It consists on temporarily deactivating some neurons within the net, preventing it from over-fitting. This temporary deactivation of neurons is typically applied only to 8 Fully-connected layers. CNNs nowadays also make extensive use of GPU processing power that allows for a faster training, an idea pioneered in 2012 that is now a standard. Evidence shows that one way of improving a CNN performance is by stacking more layers and making the network effectively deeper The problem that often arises is that as more layers are stacked, the performance saturates and eventually starts to decrease at some point. To address this issue, the idea of deep residual networks has been proposed. Residual Networks try, with minor changes to the architecture, and with virtually no impact on performance, to approximate residual functions instead of standard functions.

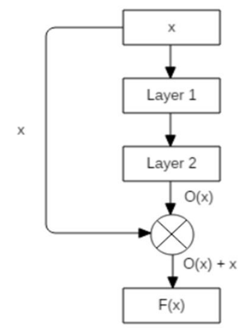


Figure 2.2: Example of a section of a CNN learning a residual function $F(x)$ instead of the function $O(x)$

If we have a CNN with input x and we want the output to approximate a function O(x), we can instead, approximate F(x) = O(x)−x and then compute O(x) from F(x) since O(x) = F(x) +x as shown in Figure 2.2. Evidence shows that CNNs train better and converge faster when the approximated function is in fact F(x), a residual function. This approach opens door for usage of even deeper and more powerful models. Some pre-processing techniques are also used to improve the data fed to the CNN. These techniques include normalization and zero-centring of the data. These techniques are mainly used in order to overcome the vanishing and exploding gradient problem, that often affects NN systems' training. Both problems arise when models are trained using gradient-based methods. Gradients are often computed using the chain rule. In case of near zero gradients, this lead to several very small numbers being multiplied together in order to calculate the changes in the last layers. This causes the last layers to suffer virtually no change at all in its outputs as the training progresses. The opposite happens when activation functions have high derivative values, leading 9 Related Work to the uncontrolled increase of the gradient of the last layers. As NN systems tend to require a lot of examples, better results are obtained when data augmentation techniques are used. CNN frameworks often incorporate mechanisms to augment data. Cropping is a very simple technique where several crops of a single image are fed to the NN, augmenting the dataset by a factor equal to the number of crops. Rotations [KSH12] of the image are also used, augmenting the dataset by a factor equal to the number of rotations done. The techniques summarised here, and others, together with a very complete set of open-source tools, foster the usage of CNNs, allowing for the fast creation of systems that perform very well in noisy datasets, clearly outperforming older image classification systems.

V. Modules Description

5.1 DJANGO Application

Django based application for providing a GUI for the user.

5.2 Tensor Flow

TensorFlow is a platform for ML and Data Science.

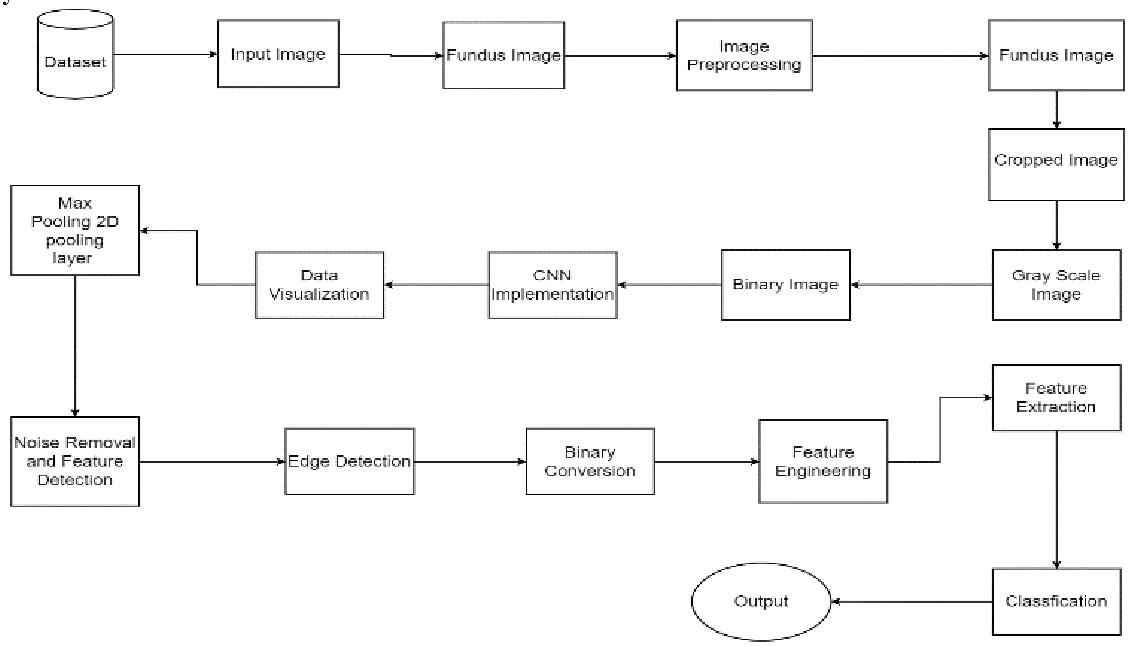
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, May 2022
IJARSCT
Impact Factor: 6.252

5.3 Open CV
It is used for getting and reading the image input from the GUI.

5.4 CNN Algorithm
The base algorithm for the whole system which takes care of the analyzing part of the system.

VI. PROJECT DESIGN

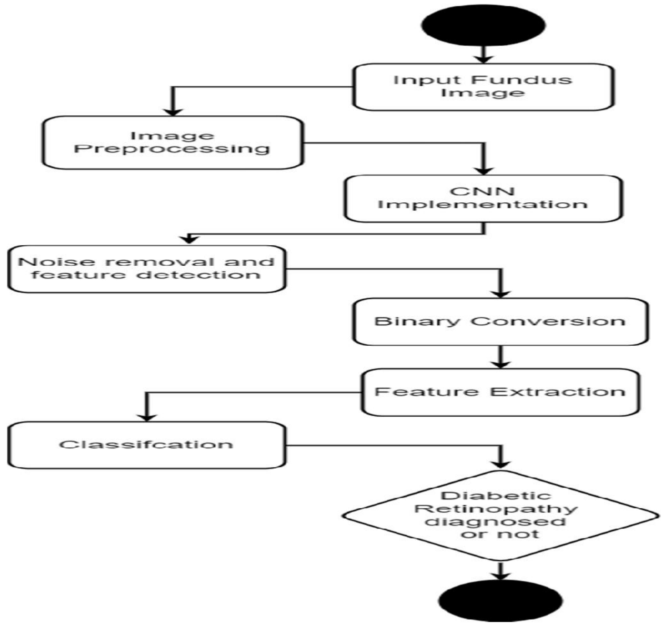
6.1 System Architecture

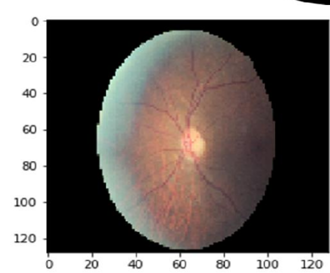


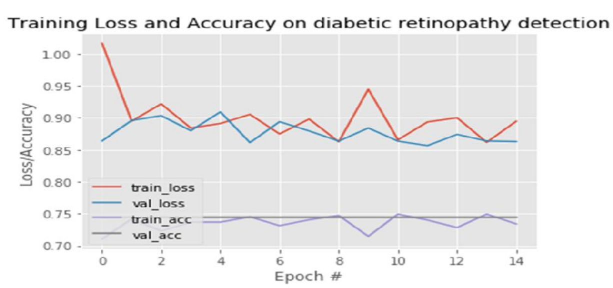
6.2 Use Case Diagram

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, May 2022
Impact Factor: 6.252

6.3 Activity Diagram







VII. Conclusion

Thus from our existing system, we can be able to eliminate many complexities faced by conventional detection systems. This system heavily impacts and possibly reduces the possibility of lags and any more inefficiencies that existed. Automated screening systems significantly reduce the time required to determine diagnoses, saving effort and costs for ophthalmologists and result in the timely treatment of patients. Automated systems for DR detection play an important role in detecting DR at an early stage. The DR stages are based on the type of lesions that appear on the retina. This article has reviewed the most recent automated systems of diabetic retinopathy detection and classification that used deep learning techniques. The common fundus DR datasets that are publicly available have been described, and deep-learning techniques have been briefly explained. Most researchers have used the CNN for the classification and the detection of the DR images due to its efficiency. This review has also discussed the useful techniques that can be utilized to detect and to classify DR using DL. The project is about proposing an optimal model for Diabetic Retinopathy detection. Processing of Retinopathy images is very essential to get proper features. Statistical values can predict level of severity properly but in case of noisy images the chances of getting poor data will lead to lower accuracy. For yielding accurate result, selecting proper features out of the image is also important.

REFERENCES

[1]. Aryan Kokane, Gourhari Sharma, Akash Raina, Shubham Narole, Prof. Pramila M. Chawan, "Detection of Diabetic Retinopathy using Machine Learning" in International Research Journal of Engineering and Technology (IRJET), 2020.

[2]. Wejdan L.Alyoubi, Wafaa M.Shalash, Maysoon F.Abulkhair, "Diabetic retinopathy detection through deep learning techniques: A review" in Informatics in Medicine Unlocked, 2020.

[3]. Yung-Hui Li , Nai-Ning Yeh, Shih-Jen Chen and Yu-Chien Chung, "ComputerAssisted Diagnosis for Diabetic Retinopathy Based on Fundus Images Using Deep Convolutional Neural Network" in Mobile information systems, 2019.

[4]. Suvajit Dutta, Bonthala CS Manideep, Syed Muzamil Basha, Ronnie D. Caytiles and N. Ch. S. N. Iyengar, "Classification of Diabetic Retinopathy Images by Using Deep Learning Models" in International Journal of Grid and Distributed Computing, 2018.

[5]. T Chandrakumar, R Kathirvel, "Classifying Diabetic Retinopathy using Deep Learning Architecture" in International Journal of Engineering Research & Technology (IJERT), 2016.

[6]. J.Lachure, A.V.Deorankar, S.Lachure, S.Gupta, R.Jadhav, ―Diabetic Retinopathy using Morphological operations and Machine Learning‖, IEEE International Advance Computing Conference(IACC), (2015).

[7]. R.Priya, P.Aruna, ―SVM and Neural Network based Diagnosis of Diabetic Retinpathy‖, International Journal of computer Applic

[8]. S.Giraddi, J Pujari, S.Seeri, ―Identifying Abnormalities in the Retinal Images using SVM Classifiers‖, International Journal of Computer Applications(0975- 8887), Volume 111 – No.6,(2015).

[9]. N.Srivastava, G.Hinton, A.Krizhevsky, I Sutskever, R Salakhutdinov, 77 ―Dropout: A simple way to prevent Neural networks from overfitting‖, Journal of Machine learning research(2014) 1929-1958

[10]. G.Lim, M.L.Lee, W.hsu, ―Transformed Representations for Convolutional Neural Networks in Diabetic Retinopathy Screening‖, Modern Artificial Intelligence for Health Analytic Papers from the AAAI(2014).

[11]. P Kulkarni, J Zepeda, F Jurie, P Perez, L Chevallier, ―Hybrid Multi-layer Deep CNN/Aggregator feature for Image Classification‖, Computer Vision and pattern recognition, ICASSP conference, (2015).

[12]. E M Shahin, T E Taha, W Al-Nuaimy, S.El Raaie, O F Zahran, F E Abd ElSamie, ―Automated Detection of Diabetic Retinopathy in Blurred Digital Fundus Images‖, IEEE International Computer Engineering Conference , pages-20- 25,(2012).

[13]. Xiang chen et al, ―A novel method for automatic hard exudates detection in color retinal images‖, Proceedings of the 2012 International Conference on Machine Learning and Cybernetics, Xian (2012). ations(00975-8887), volume 41- No.1,(March 2012).

[14]. Vesna Zeljkovi et al, ―Classification Algorithm of Retina Images of Diabetic patients Based on Exudates Detection‖, 978-1-4673-2362-8/12, IEEE(2012)

[15]. J. Grekow, "Emotion Detection Using Feature Extraction Tools." In International Symposium on Methodologies for Intelligent Systems,(2015, October), (pp. 267-272). Springer, Cham.

[16]. K. Han, T. Zin& H. M. Tun, "Extraction Of Audio Features For Emotion Recognition System Based On Music", In International Journal Of Scientific & Technology Research , (JUNE 2016).

[17]. A. Wieczorkowska, P. Synak, R. Lewis, & Z. W.Raś, "Extracting emotions from music data." In International Symposium on Methodologies for Intelligent Systems (2005, May) (pp. 456-465). Springer, Berlin, Heidelberg.