Bharath
INSTITUTE OF HIGHER EDUCATION AND RESEARCH
(Declared as Deemed-to-be University under section 3 of UGC Act, 1956)
(Vide Notification No. F.9-5/2000 - U.3, Ministry of Human Resource Development, Govt. of India, dated 4th July 2002)
Accredited by NAAC
NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL
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Chennai - 600 073. Tamil Nadu.

Ref No.SMS-2018-O-06

Date: 17/04/2019

TO

Mr. T.Vijayan,

Asst. Professor/ECE,

BIHER.

BHARATH INSTITUTE OF HIGHER EDUCATION & RESEARCH
(Declared as Deemed to be University U/S 3 of UGC Act 1956)
17 APR 2019
OFFICE OF THE DEAN-RESEARCH
Selaiyur, Chennai-600 073. INDIA

Thro: Concern Head of the Department

Greetings!!!

We are happy to announce that the Research Advisory Committee has approved your proposal for Seed Money Scheme-2018 which was presented by you. You are requested to complete the proposal and send the progress report to the Dean Research in the prescribed time period.

Title of the Project: Diabetic Retinopathy on Retinal Fundus Images using Deep Learning Techniques with Inception V3 Architecture

Seed Money Amount: Rs.1, 00,000/- (Rupees One Lakh Only)

Approved on: 17/04/2019

Payment details:

Voucher No.06 **Dated: 19/04/2019**

With Regards

Dean-Research

Bharath University

SELAIYUR, CHENNAI - 600 073, TAMIL NADU, INDIA.

CASH / PAYMENT VOUCHER

Date 19/04/19

V.No. 06

Debit _____ Amount

Rs. 1,00,000/-

PAID TO Mr. T. VIJAYAN

RUPEES One Lakh only

TOWARDS Seed Money Schema - 2018

Authorised by **Finance Manager** **Cashier/Accountant** **Payee's Signature**

PROPOSAL SUBMISSION

1. **Details of Principal Investigator**

Name	: Mr.T.Vijayan
Designation	:Assistant Professor
Highest Qualifications	:M.E., (Ph.D.)
Department	:Electronics and Communication Engineering
E-mail	:vijayan.ece@bharathuniv.ac.in
Contact no	:9894857331
Date of Joining	:08.07.2010

2. **Details of Co - Principal Investigator**

Name	:Dr. M. Sangeetha
Designation	:Professor
Highest Qualifications	:Ph.D.
Department	:Electronics and Communication Engineering
E-mail	:sang_gok@yahoo.com
Contact no	:9884221512
Date of Joining	:27.11.2015

Technical details

1. Introduction

Diabetes is one of the challenging health issues that occur when your blood sugar is too high but the body cannot produce enough of the hormone insulin. In worldwide 463 million people are having diabetes in 2019, International Diabetes Federation is projected that the count will reach 578 million, by 2030, and 700 million by 2045. People with uncontrolled diabetes are more likely affected by a list of eye-related problems such as diabetic retinopathy, cataracts, diabetic macular edema, and glaucoma. DR is common challenging eye diseases which are caused by who have more than 20 years in diabetes. As DR early prediction and treatment planning to prevent eye vision loss. The DR has two major categories: Proliferative Diabetic Retinopathy (PDR) and Non Proliferative Diabetic Retinopathy (NPDR).In the early-stage DR is called NPDR, this stage will weaken or bulge the retinal blood vessels or it may leak into the retina. The deadliest stage of DR is called proliferative DR (PDR), this stage unwanted blood vessels are newly growth in the eye and also Blood leakage presented in the part of retina.

Deep learning models are better in performing classification tasks on medical images for disease diagnosis. Fine-tuning of popular Convolutional Network (CNN) with pre-trained weights is the most preferable technique to speed up the learning capability of the model. The proposed effort fine-tunes the popular InceptionV3 CNN architecture with pre-trained weights obtained during the training process with the ImageNet database, for detecting the presence and severity of DR in binary class classification tasks. The proposed approach and the chosen architecture reduce the model's training time and increases classification accuracy with higher sensitivity and specificity. It helps the ophthalmologist and eases the diagnosis task.

2. Review of status of Research and Development in the subject

Diabetic retinopathy detection using red lesion localization and Convolutional neural networks -Gabriel TozattoZago , Rodrigo VarejãoAndreão, Bernadette Dorizzi, EvandroOttoni ,TeatiniSalles

The proposed deep learning model achieved comparable or better results with only a small fraction (<1/4) of training set images than used recently by two other groups to obtatin the state-of-the-art results in the non-referable /referable diabetic retinopathy(NRDR/RDR) classification, with similar model architecture. In the proposed system,the classifier was trained on five different input image sizes, for each of the five classification systems. . In all tasks, the best performing model according to AUC/macro-AUC metric was the model with the largest resolution, namely the images of 2095 × 2095 pixels, except that under the QRDR classification the best results were achieved with image sizes of 1024 × 1024 and 2095 × 2095 pixels. It was observed that the AUC performance overall increased with the input image size, which could be attributed to the fact that the amount of information and features in the images increases with the image size.

Automatic Detection of Diabetic Retinopathy in Retinal Fundus Photographs Based on Deep Learning AlgorithmFeng Li 1 , Zheng Liu 1 , Hua Chen 1 , Minshan Jiang , Xuedian Zhang 1 , and Zhizheng Wu

For discrimination between no referral (no apparent DR and mild NPDR) and referral (moderate NPDR, severe NPDR, and PDR), we also computed prediction accuracy, sensitivity, specificity, area under the receiver operating characteristic curve (AUC),and j value. The proposed approach achieved a high classification accuracy of 93.49% (95% confidence interval [CI], 93.13%–93.85%), with a 96.93% sensitivity (95% CI, 96.35%–97.51%) and a 93.45% specificity (95% CI, 93.12%–93.79%), while the AUC was up to 0.9905 (95% CI, 0.9887–0.9923) on the independent test dataset. The j value of our best model was 0.919, while the three experts had j values of 0.906, 0.931, and 0.914, independently. The Proposed method automatically detect DR with excellent sensitivity, accuracy and specificity.

Segmentation of retinal blood vessels from ophthalmologic Diabetic Retinopathy imagesT. Jemima Jebaseelia , C. Anand Deva Durai b, J. Dinesh Peter

The proposed method uses Contrast Limited Adaptive Histogram Equalization (CLAHE) for preprocessing and Tandem Pulse Coupled Neural Network (TPCNN) model for automatic feature vectors generation then classification and extraction of the retinal blood vessels via Deep Learning Based Support Vector Machine (DLBSVM). The proposed approach is assessed over the standard public fundus image databases to evaluate the performance. The results render that these techniques improve the segmentation results with an average value of 74.45% sensitivity, 99.40% specificity, and 99.16% accuracy. The results evoke that the proposed method is a suitable alternative for supervised techniques.

Severity analysis of diabetic retinopathy in retinal images using hybrid structure descriptor and modified CNNs C. Mahiba, A. Jayachandran

For Diagnosis and Treatment Plan for diabetic retinopathy play a major role among researchers in the field of computer vision . In this ,efficiency of the accuracy will be improved by proposed method. In this proposed method , multi class lesion classification system of retinal image is developed based on hybrid color and texture features and modified CNNs. The overall classification accuracy of the proposed HTF with MCNNs is 98.41%, but the existing methods HTF with SVM and HTF with CNNs produce 97.84% and 96.65% respectively.

2.1 International Status: Nil

2.2 National Status: Nil

3. Progress/achievement so far,

a) Data Set Preparation (Retinal fundus image public data set)

b) Review of done based on research

c) The proposed done by fine-tunes the popular InceptionV3 CNN architecture with pre-trained weights obtained during the training process with the ImageNet database, for detecting the presence and severity of DR in binary class classification tasks..

4. Work Plan:

4.1 Methodology

The materials/terms used for this experimentation are defined for the sake of increasing the readability for proposed framework with clarity. Moreover, the rationale behind the classifiers and their demonstration models are discussed in this section.

Data Preparation and Description

The data used for developing the model was obtained from Indian Diabetic Retinopathy Image Dataset (IDRiD). Hence the analysis and identification of Diabetic Retinopathy are more suitable for the Indian population. This data contains the indication on the disease severity of diabetic macular edema and diabetic retinopathy along with good resolution retinal fundus pictures taken by Fundus Cameras. The data was released for the "IEEE International Symposium on Biomedical Imaging (ISBI) 2018 Challenge 2".

The dataset covers 516 retinal fundus images, out of which 412 images are allotted for training the model and 104 images for validating it. These images are labeled by an experienced

pathologist according to a scale from 0 to 4 associated with, „Moderate", „Mild", „Severe " , „Proliferative DR"and „No_DR" correspondingly as the class labels for the image. We consider our experiment according to binary classification task disease grading level represented by label 0 (No DR) and 1(DR).Table1 provides Experimental Image dataset for binary class.

S. No	Diabetic Retinopathy Types	Instances Count	Class Description of Diabetic Retinopathy (DR)
1	No_DR	168	DR not present
2	Diabetic Retinopathy	348	DR present

Table 1:Experimental Image dataset for binary class

Contrast Limited Adaptive Histogram Equalization (CLAHE)

CLAHE technique is used for enhancing the local contrast of the input retinal image. As a result, the visibility of the diabetic retinopathy identification signs like retinal blood vessels, microaneurysms, hemorrhages, and exudates was improved and clearer to decide on the pre-processed images

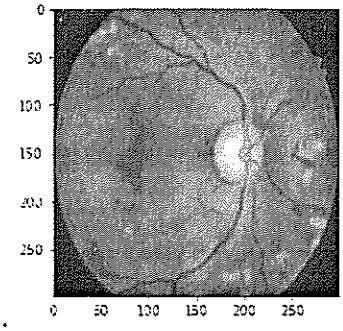


Fig 1:Retinal image

Deep Transfer learning based on InceptionV3

Transfer learning is a new classification platform to perform Medical image disease identification and severity analysis. This method reduces the required training time and produces better prediction accuracy in network performance. We selected the Inception V3 network, it's pre-trained with more than a million images from the ImageNet database. The pre-trained network can classify images into 1000 classes and each class representing a particular object. Inception V3 architecture consisting of five layers for performing convolution, two max-pooling layers, 11 inception modules, one average pooling layer, and one fully connected (FC) layer, which produced an image-wise categorization.

we transferred pre-trained weights from the inception v3 network and further Fine-tuning process involves the following steps, (i) unfreezing the last two layers in the Inception V3 network (ii) adding 2 more FC layers to convert the existing Inception v3 model for diabetic retinopathy application. 1000 output classes of the Conventional inception v3 model were reduced to binary classes representing DR stages due to the fine-tuning process. Whereas trained weights before the last 2 layers are unchanged.

The tuning process increases the performance accuracy and ROC values for the transfer learning network. The flow chart describes the working flow of the inception V3 fine-tuning model shown in Fig 2. Tunning process We add first Dense layer with Relu activation function and Drop out 0.5 and final dense layer with SoftMax activation function used to perform the model.

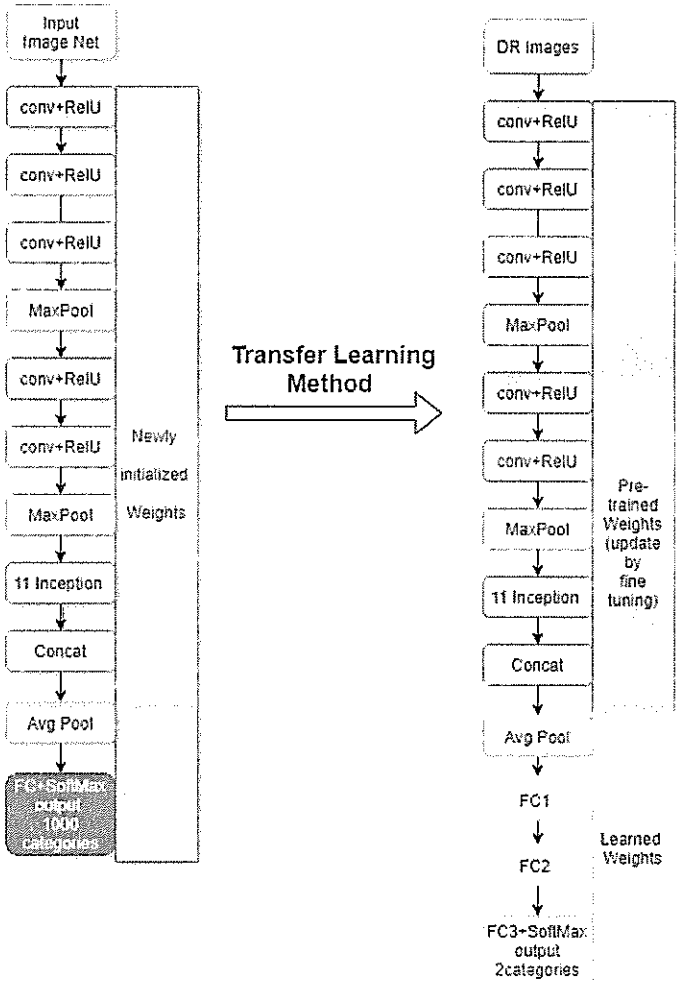
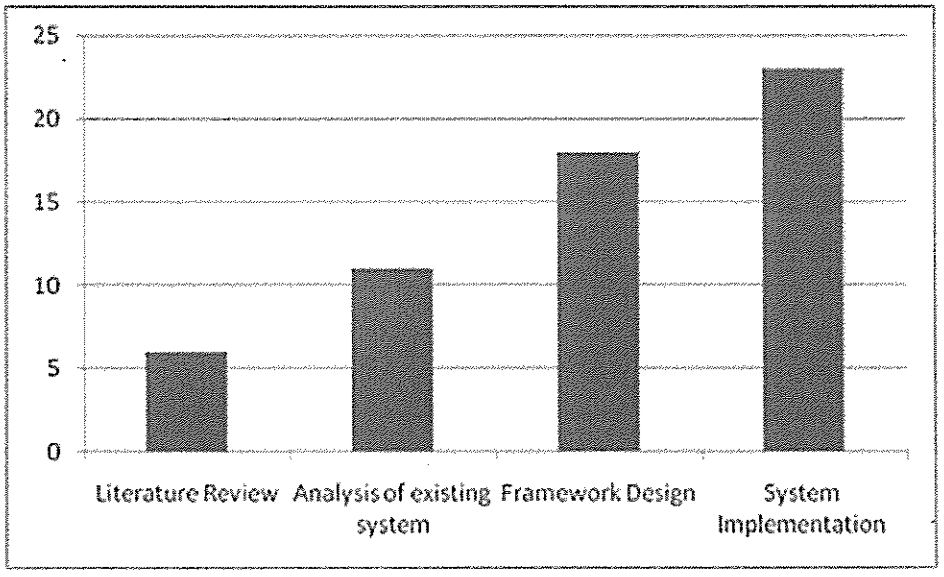


Fig 2: Deep transfer learning approach with Inception V3 architecture.

4.2 Time Schedule of activities giving milestones through BAR diagram.

Work plan (including detailed methodology and time schedule)

Sl. No.	Activity / Milestone	1st Year		2nd Year	
1.	Literature Review	1-6			
2.	Analysis of existing system		7-12		
3.	Framework Design			13-18	
4.	System Implementation				19-24



4.3 Expected outcome within the time period of Seed Money Scheme

a) Deep Transfer learning Architecture Design within the first half time period of Seed Money Scheme.

b) Classification and result analysis work can be done within the second half time period of Seed Money Scheme.

5 **Suggested Plan of action stating the name of funding agency where the project will be communicated for financial support within the time period of project.**

Nil

6 **Bibliography:** Nil

7 List of Projects submitted/implemented by the Investigators (Separate for Pi and Co-PI)

Nil

7.1 Details of Projects submitted to various funding agencies:

S.No	Title	Cost in Lakhs	Month of Submission	Role as PI/Co-PI	Agency	Status
	NA	NA	NA	NA	NA	NA

7.2 Details of Projects under implementation

Sl. No.	Title	Cost in lakhs	Duration	Role as PI/ Co-PI	Agency
	NA NA	NA	NA	NA	NA

7.3 Details of Projects completed during the last 5 years

Sl. No.	Title	Cost in lakhs	Duration	Role as PI/ Co-PI	Agency
	NA	NA NA	NA	NA	NA

8 List of publications published by the Investigators, if any:

a) Co - Principal Investigator

Sl.No	Details
1	Vani Rajamanickam, Sangeetha Marikkannan, T. Rajavelu," An Hybrid Motion Estimation Algorithm For Video Coding Standards", International Journal of Applied Engineering Research, ISSN 0973-4562 Volume 10, Number 2 (2015) pp. 4885-4894
2	Vani Rajamanickam, Sangeetha Marikkannan and Sharmila Ganesan, An Improved

	Motion Estimation Search Algorithm for H.264/AVC Standard, VOL. 10, NO. 6, APRIL2015 ISSN 1819-6608, ARPN Journal of Engineering and Applied Sciences, pp. 1-6.
3	Vani Rajamanickam and Sangeetha Marikkannan, An efficient Motion Estimation Algorithm for Search point reduction in Video Coding, International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 10 No.33 (2015)
4	Vani Rajamanickam and Sangeetha Marikkannan, A New hybrid search algorithm with novel Cross-Diagonal-Hexagon Search Video Coding Algorithm for Block Motion Estimation, Wireless Personal Communications, Springer(2015)Vol 88,No2 pp. 211-222
5	Vani Rajamanickam, Sangeetha Marikkannan, "Efficient Block-based Motion Estimation Architecture using Particle Swarm optimization", International ARAB Journal of Information Technology , Vol 13 (6A) pp. 732-739 , 2016 Print ISSN 1683-3198 Jordan Zarka Private Univ
6	Dr M.Sangeetha, Control contruct estimation for Partitioned Binaries in Codesign System, International Journal of Advanced Research in Innovative Discoveries in Engineering and Applications, Vol. 1 No 1, October 2016, pp.22-27
7	R. Vani, N. Ushabhanu, M. Sangeetha,' Fast Motion Estimation Algorithm using Hybrid Search Patterns for Video Streaming Application' International Journal Of Computers Communications & Control, ISSN 1841-9836,, 12(5), October 2017, pp.715-727.
8	M.Sangeetha, N. Gokul, S Arulselvi, "Estimator for control logic in high level synthesis" International journal of pure and Applied Mathematics, Volume 116, Issue 20 Special Issue, 2017, pp. 425-428
9	M.Sangeetha, N. Gokul, S Arulselvi," Comparative study on motion estimation algorithm for video coding standards" International journal of pure and Applied Mathematics, Volume 116, Issue 20 Special Issue, 2017, Pages 431-435

b) Principal Investigator

Sl.No	Details
1	Presented & published paperin IEEE organized "International conference on Human computer interactions"(ICHCI'13) at Saveetha University on "An Improved Low-Resolution Face Tracker System Using Gradient Logarithm Field Feature Space and Bicubic interpolation" IEEE DOI:10.1109/ICHCI-IEEE.2013.6887823, page(s) 1-7,Aug 2013.
2	Vijayan T, "Glaucoma Detection Based on Optic Disc and Optic Cup Segmentation Using Feed Forward Neural Network" for the International Journal of Applied Engineering Research, Vol 10, No 6, 2015,PP: 15857-15868
3	Vijayan T, "MPEG-4 Motion Pictures Enciphering and Deciphering Techniques Using VHDL" for the International Journal of Pure and Applied Mathematics, Vol 118, No 18, PP: 809-819, 2018.
4	Vijayan T,"Optimized Thresholding Techniques for Reducing Random Impulse Noise" for the International Journal of Pure and Applied Mathematics, Vol 118, No 18, PP: 799-808,2018.
5	T.Vijayan, "Application Of Ultra-wide Band Radiation In Securing RFID" for the International Journal of Pure and Applied Mathematics, Vol 118, No 8, 2018,PP: 493-501.

CERTIFICATE FROM THE INVESTIGATOR

Project Title: Diabetic Retinopathy on Retinal Fundus Images using Deep Learning Techniques with Inception V3 Architecture

It is certified that

1. I do hereby agree to submit a complete proposal for financial support to the external funding agency within the time period of SMS-2018

2. I undertake that spare time on equipment procured in the project will be made available to other users.

3. I agree to submit a certificate from Institutional Biosafety Committee, if the project involves the utilization of genetically engineered organisms. I also declare that while conducting experiments, the Biosafety Guidelines of Department of Biotechnology, Department of Health Research, GOI would be followed in to.

4. I agree to submit ethical clearance certificate from the concerned ethical committee, if the project involves field trails/experiments/exchange of specimens, human & animal materials etc.

5. I agree to abide by the terms and conditions of SMS-2018, BIHER, and Chennai.

Name and signature of
Principal Investigator

Name and signature of
Co-Principal Investigator

Date: 27.02.2019
Place: Chennai - 73

Forwarded by Head of the Department

Signature of the Head

PROJECT EVALUATION FORMAT

Recommendation Sheet

Name of the Principal Investigator	T.Vijayan
Name of the Co-Investigator	Dr. M. Sangeetha
Name of the Department	ECE
Title of project	Diabetic Retinopathy on Retinal Fundus Images using Deep Learning Techniques with Inception V3 Architecture
Recommendation of the evaluation committee	-Recommended-
Financial allocation recommended	Rs. 1,00,000-

Sl. No.	Equipment /Soft ware	Quantity	Amount in INR
1.	Software cost and Design implementation		60,000/-
2.	Consumables		15,000/-
3.	Travel support for the purpose of research work.	---	5,000/-
4.	Contingency	---	10,000/-
5.	Others	---	10,000/-
	Total		1,00,000/-

Name and Signature of the Research Advisory Committee members with date

Dr. P. Naveenchandran

Internal Quality Assurance Cell IQAC Selaiyur Chennai-79. BIHER