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Research Article

Identification And Classification Of Eye Disease Using Deep Learning

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Abstract

As The World Is Moving Into The World Of Technology Classification Of The Eye Disease Is Considered To Be Having A Clinical Use As It Evaluate And Analysis The Results. Requirements For The Classification Of The Eye Disease Should Be Simple In Nature, Structure And Evaluation. Diabetics Retinopathy Is One Of The Most Widely Spreading Eye Diseases Which Is Found In People With Diabetics, It Is Caused By Damaging The Blood Vessels In The Retina Which Began To Leak Fluids And Blood When This Fluid Leaks It Causes Macular To Swell Or Thicken Which Raises To Disease Called Diabetic Macular Edema (Dme). Glaucoma Is One Among The Leading Causes Of Unchangeable Vision Loss Which Is Additionally One Among The Various Approaches Have Recently Been Proposed For Automatic Glaucoma And Diabetic Macular Edema Detection Based On Fundus Images.Using Convolutional Neural Network Which Is The Classification Of Deep Learning, Can Conclude A Hierarchical Representation Of Images To Classify Between Normal And Diseased Eye Patterns For Diagnostic Decisions .Thus The Target Of This Paper Is To Implement And Define The Deep Learning To Identify And Classify The Eye Disease.

Keywords: Diabetic Lesion, Diabetic Macular Edema, Glaucoma, Cnn, Fundus Image, Eye, Image Processing

I Introduction

Diabetes Is One Of The Most Wide Spreading Epidemic Problem That Is Reported Nowadays, About 18 Million People Affect Every Year From Cardiovascular Disease Where Diabetes Is One Of The Important Factor In Causing Of This Disease .Who Reportedly Defined, Diabetes Has Become The Fourth Leading Cause Of Blindness Across The Globe. Around 60 Million In India Is Affected By Diabetic Eye Disease. Thus It Is One Of The Diseases To Look Upon In The Near Future To Prevent From Any Kind Of Misleading. Thus Identifying These Eye Diseases And Subjecting Them Into Treatment Will Pay A Huge Road For The Human Kind To Step Into The Land Of Wellbeing. Images Is One Of The Most Widely Used Factor In Everyone's Life Without One's Notice, From The Movement We Wake Up Till We Close Our Eyes We Are Constantly Capturing Picture In Our Mind And Processing Those Photos Will Lead Us To The Identification Of Object And Action .With The Base Of This Process It Leads To A Method Called Convolutional Neural Networks(Cnn) Which Is The One Among The Type Of Deep Learning .In This Method The We Achieve End To End Training And Testing Dataset ,As We Feed The Fundus Image(Photography Of Rear Of Eye) As Input And Receiving The Output Of The Image Or Result Based On The System .In The Paper We Are Going To Discuss About The Classification Of The Various Eye Disease Caused By The Diabetics, Those Are Diabetic Lesion, Diabetic Macular Edema, Glaucoma Using The Image Provided As Input .Before Going Deep Into The Concept Let Us Understand The Causes Of These Disease .Diabetics Is The Type Of Disease That Is Caused By The When The Person Body Fails To Segregate Enough Insulin ,As This Substance Is Important In Breaking Up The Glucose In One's Body . When The Retinal Veins Are Blocked, It Does Not Flow Properly Which Lead To Leakage In Retina ,As It Is The Sensitive Part Of The Eye. If It Continuously Leak Into Macula It Lead To Macular Edema. Leakage Is Increased By The Severity Of The Blockage .As Macula Is The Main Cause For The Straight Vision (Centre Vision), So Any Damage Into Macula Leads To Blurry Vision .Thus Identification And Treatment Of This Will Help In Reducing The Vision Loss Also Reduces The Number Of Accidents That Are Happening In Day To Day Life Around The World [3]. If There Is Damage In The Optic Nerve Of The Humans Eye It Leads To Blindness Which Is Caused By The High Pressure In The Blood Vessels Around The Eye, Which Leads To Disease Called Glaucoma. As The Identification Of This Disease In Early Stage Is Important Once It Crosses The Line Then Obtaining Back The Vision Loss Leads To The Road Of Impossible. Diabetic Lesion Is Caused By The Burst Of The Choroidal Optic Nerve Which Leads To The Growth Of The Extra Substance Which Is Not Cancer. Thus These Are The Various Eye Disease, Identification Of These Damages In Eye Retina Require Long Time Sometimes We As Humans Tend To Skip Another Developing Disease In The Eye Thus Here We Implement The

Algorithm Of Cnn To Identify The Type Of Eye Disease And Provide The Accuracy Of The Mostly Affected Disease.

Ii Literartue Survey

First "A Multiscale Optimization Approach To Detect Exudates In The Macula" [1], The Model Obtained Auc Of 0.96 For The Two Databases When They Are Combined As One Database And Auc Of 0.97 Is Obtained When Each Database Are Evaluated Independently. Where They Used 400 Images Form Messidor And 652 Images From Uthsc Sa, As The Dataset And Trained The Algorithm With The 52 Image Of Uthsc Sa. From [2] They Checked Macular Edema Diseased Image To The Count Of 30, Where They Are Processed And Evaluated The Severity Of The Disease And Classify Them Among Those 9 Is Defined As Normal, 8 As Moderate And 13 As Sever From The Digital Fundus Image. From [5] They Have Implemented The Automatic Method As It Identify The Affected Area And Grade That Affected Area Of Exudates Using The Algorithm Of Svm For Classification And Feature Extraction For The Area Identification As It Defines With More Accuracy And Simplicity. From [16] They Have Implemented The Architecture Of Dl Which Contains Six Learned Layer, With Four Convolutional Layers And Of Two Fully Connected Layers As They Also Included The Dropout And Data Augmentation Technique To Improve The Performance Of The Detection Of The Disease Glaucoma With The Auc Of 0.831 And 0.887.From [6] It Defines That For The Detection Of The Edema With Macula As Centre Using Computer Feature Extraction ,As Obtains The Accuracy ,Specificity Of 86% And 75% Using Classifier Of Support Vector Machine(Svm) As It Also Defines The Difference Between Normal And Abnormal Eye. From [21], It Studies The Difference Between The Performance Between The Method Which Implied With Deep Learning And Without Deep Learning As From This The Model That Implied Deep Learning Has Better Performance With The Sensitivity Of 96.8% When Compared To Those Who Did Not Apply Deep Learning Of 94.4%.

Iii Proposed System

In This Paper We Discuss A Method Of Deep Learning Using Convolutional Neural Network As It Contains Three Important Layers Thus Each Layer Performs Particular Function And It Also Act As A Classifier. The Three Layers Are Convolutional Layers, Pooling Layers And Fully Connected Layers (Fc). In The Proposed System The Images (Rgb Image) Are Taken Into The Process By Mentioning The Path And They Are Reshaped Into The Size Of 200*200*3 And By Using 3*3 Matrix Filter As The Input Images Vary In The Dimensions Thus The Convolutional Layer Contains Filters So It Is Reshaped Into The Desired Image Size And Passes To The Succeeding Layers. The Noise In The Images Are Removed And Maximum Pooling Application Is Implemented To Identify The Maximum Point And Based On These Maximum Point The Testing Is Done. As This Model Is Fast, Readily Available, Highest Spatial Resolution.

Iv Module Description

(I) Collect The Training Dataset

We Begin By Downloading The Images, As These Images Are Taken From The Database Of Messidor, Into Matlab. Datasets Are Stored In Many Alternative File Types. This Data Is Stored As Binary Files In Which Matlab Able To Access Quickly.

(Ii) Train The Dataset

First For The Training Of The Data Set We Need To Obtain The Database And Must Know The Size Of It ,Thus After Acquiring The Idea Of The Database , Splitting Of Data Comes Into Action There Are Many Ways For Splitting As The Famous Ratio Of Split Between The Train And Test Is Found To Be 70:30 Ratio Or 50:50, As They Are Finalized Based On The Size Of The Dataset, As For Deep Learning They Also Provide A Way For The Ratio Of 99:1 . Just In Case Of Images, They'll Be Geometric Features, Texture Features Etc. Now, For Deep Learning We Need To Provide The Data That Are To Be Trained To The Classifier As It Builds The Model

According To The Data's That Are Trained And Obtain The Various Feature That Are Needed To Be Verified During The Testing Period As Disused Earlier They Are Of Ratio Of 70-30 Or 50-50 .These Model May Be Validated And Obtain The Optima Kernel Parameters Such As Accuracy Etc. As K-Fold Cross Validation Is The One Among The Only Ways To Decide On The Identities .There Also Are Several Algorithms That We Look For Selecting Good Features .Once The Feature Extraction And Model Are Defined And Build We Will Be Able To Test The Classifier And Evaluate The Accuracy Based On The Information Obtained From The System.

(Iii)Classification

Deep Learning Has Many Classifications, But Among Those Convolutional Neural Network Is The Foremost Famous And Is Being In Rise Of The Utilization And It Is More Standard And Go To Algorithm In Image Classification . In General, The Cnn Architecture Contains Three Kinds Of Layers, Which Are Convolutional Layers, Pooling Layers, And Fully Connected Layers. As The Convolutional Layers Act As The Filter As It Extract The Features From The Image Given. Pooling Layer Does The Same Operation As Convolutional Layer But The Difference Is That They Perform Function Called Max Polling Where The Maximum Values Are Taken From The Filtered Region. The Fully Connected Layer Does The Operation Of Connecting The Various Layers That Are Obtained From The Operation Of The Previous Layers And Aggregate The Information To The Final Mapping. The Cnn Algorithm Receives An Input Image As It Passes Through The Various Layers To Identify And Spot The Feature And Classify Them Based On The Results Obtained. The Output Of Every Layer Within The Cnn Is That The Input Of The Subsequent Layer. The Input Image Can Be Defined In 3d Of Width × Height × Depth, As It Can Also Work On One Dimension Or Three Dimensions. As The Reason For The Utilization Of The Utilization Of The Cnn As The Classifier Other Than Any Other Predecessor Is That, It Automatically Detects The Important Feature From The Images Which Is Subjected As Input Without Any Human Supervision. As It Also Out Performs When Compared To Other Classifiers Namely Nns, Svm Etc. Thus In This Model We Implement The Algorithms Of Cnn, Classify And Identify The Type Of Eye Disease Which Is Found In The Input Rgb Image.

V Flow Diagram

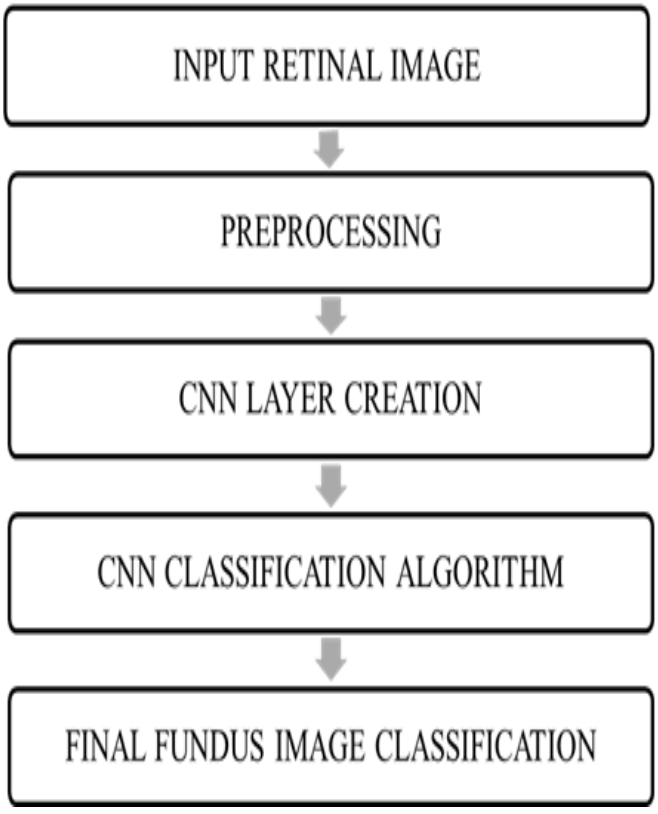

Fig 1. Flow Diagram Of The Model.

Vi Input Retinal Image

Fig 2 **Fig 3**

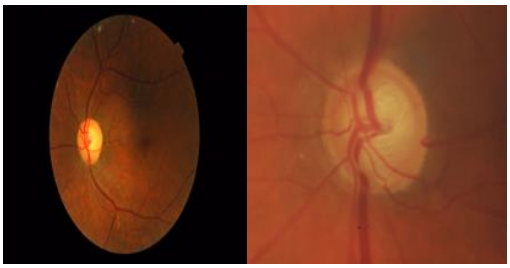

Fig 4 **Fig 5**

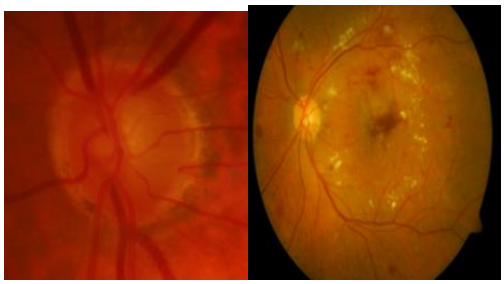

Fig 6 **Fig 7**

The **Fig 2** Is The Fundus Image Of The Healthy Eye Ball With The Pupil And The Retina In The Perfect Condition, Whereas The **Fig 3** Is The Damaged Retina With The Leakage Of Vessel Which Lead To The Classification Of The Macular Edema With The Moderate Of Infection In The Retina .The **Fig 4** Is The Severe Infection Caused Due To The High Pressure Found In The Vessel Lead To The High Level Of Macular Edema. The **Fig 5** Is The Fundus Image Of The Pupil Of The Eye , As It Is Classified As Healthy Eye Pupil .**Fig 6** Is The Damaged Pupil With The Rapture Of Blood Vessels And It Is Classified As Glaucoma. The **Fig 7** Is The Mostly Damaged Eye Ball With The Rapture Of The Choroidal Optic Nerve Which Leads To The Growth Of Substance And It Is Classified As The Diabetic Lesions.

Vii Red Green Blue (Rgb):

The Rgb Colour Model Is An Addition Of Colours Of Red, Blue And Green Where These Supplementary Colours Are Combined In Various Unique Ways To Produce A Different Array Of Colours. The Main Utilization Of The Rgb Model Image In Electronic System Is To Sense, Represent And Display The Resulted Image. This Rgb Image Has Been Used In Conventional Systems. This Is Fully Depend On The Human Perception Of Colours .In This Different Devices Reproduce Or Detect A Input Rgb Value Differently, Since The Elements Of Colour R, G And

B Response Differ From One System To Another Or In The Same System They Tend To Change As The Time Increases .Thus Without Some Kind Of Colour Management, The Rgb Value Does Not Define The Same Colour For All The Devices. Thus The Some Of The Input Rgb Devices Are Video Camera, Digital Camera And Tv. The Some Of The Rgb Output Devices Are Video Projectors, Mobile Phone Displays. In The Rgb Representation Of Fundus Image ,Each Pixel Holds The Colour Intensity Values (Red, Green And Blue).The Values Of These Intensity Ranges From 0 To 255.0 The Darkest Region And 255 Being White For Each Colour.

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Viii Preprocessing

The Process Of Transferring All The Information Or Some Of The Information Before Subjecting Into The Model Or Algorithm Of Machine Learning Or Deep Learning. Sometimes If The Input Raw Image Is Fed Into The Algorithm Will Lead To The Bad Or Inaccurate Classification Of The Data. Thus Before Feeding The Raw Input Image Into The Algorithm We Must Pre-Process The Data .A Preliminary Processing Of Knowledge So As To Arrange It For The First Processing Or For Further Analysis. As An Example, Extracting Data From A Bigger Set, Filtering It For Various Reasons And Mixing Sets Of Knowledge Can Be Pre-Processing Steps. Data Pre-Processing Is A Crucial Step To Arrange The Information To Create A Qspr Model. Data Cleaning And Transformation Are Methods Won't To Remove Outliers And Standardize The Information In Order That They Take A Form Which Will Be Easily Wont To Create A Model.

Ix Matlab

Matlab Also Known As Matrix Laboratory Is A Numerical Fourth-Generation Linguistic Communication. Matlab Is Used As A User In Various Departments Such As Economics, Science And Engineering. It Is Widely Used In Research And Academic Institutions As It Plays An Important Role In The Simulation As An Industrial Enterprise. For Educational Purposes, It Is Used In The Teaching Of Algebra And In The Analysis Of Numerical Calculations. In Matlab Language, The Matlab Application Is Created And The Executable Code Is To Be Typed Within The Command Window, Which Is Present In Matlab Desktop. When Code Is Typed In Command Window, The Sequences Of Command Are Going To Save In Exceedingly Data File, With The Help Of The Matlab Editor And The Script Of This Code Is Encapsulated To A Function, Which In Return Extends The Commands That Is Available In The Code. It Also Provides Features For Documentation Purposes And Sharing Of Your Work .After All This, Matlab Will Ready To Integrate The Code With The Other Languages And The Applications Available. The Features Are Application-Oriented Language For Technical Computations, For Managing The Code, Files And Data The Environment Is Developed And To Perform Mathematical Functions Like Algebra, Statistics, Optimization, Filtering And Numerical Integration Like Plotting Of 2d And 3d Graphical Function For Data Visualization.

X Convolutional Neural Network

Cnn Stands For Convolutional Neural Network Which Is A Unique And Exclusive Neural Network Which Has Input As Images Which Is The 2d Matrix Of Pixel Which Is Processed To Obtain The Results Of The Input Given, Thus They Are Used For Image Detection And Classification. As Explained Earlier Images Are Made Of 2d Matrix Of Pixel In Which Cnn Can Run To Classify Or To Recognise The Input Image. We Use Visual Perception Model Proposed By Hubel And Wiesel. The Idea Behind To Create This Model Is To Train The Model To Think And Apply Like The Working Of Humans Neural System, Thus They Come Under The Neural Networks. A Convolutional Neural Network (Cnn) Is A Deep Learning Algorithm As They Use Three Layers As Discussed Earlier With The Convlayer And Relulayer. The Convlayer Act As A Filter As It Extracts The Feature From The Image .The Relulayer Act As A Rectifier As It Enhances The Non-Linearity Of The Image. As Cnn Comes Under The Algorithm Of Deep Learning And The Working Of This Is To Take An Input Image And Assign The Weightage To The Image To Be Able To Differentiate From The Opposite Part Of The Image. Utilization Of The Algorithm Is That It Provides High Accuracy Thus They Are Used In Image Classification And Recognition. As Cnn Utilises The Model Of Hierarchy Where It Builds A Network, A Funnel And As A Last Layer Contains Fc Where The Layers Are Connected And The Output Is Processed. So The Main Utilization Of This Algorithm Which Is Cnn Is That It Do Not Require Any Human Supervision, It Is Flexible And Also Can Work With Any Image Data. Thus Most Of The Models When Its Main Requirement Is To Do The Classification, Cnn Provide A Good Helping Hand In Obtaining The Desired Accuracy.

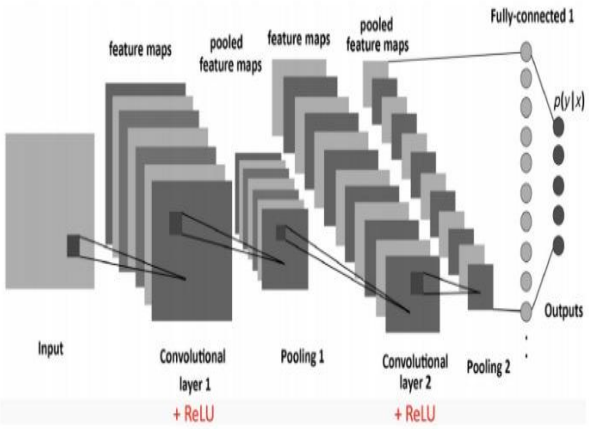

Fig 8 Layers Of Cnn

From The Above Figure We Can Completely Understand The Working Of Layers Of The Cnn. The Convolutional Layer Is The Foremost Layer To Extract The Characteristics From The Input Images .In This Layer In Between The Input Image And Filter Of Specific Size Mxm The Convolution Operation Is Performed. The Dot Product Is Performed Between The Images That Are Taken As Input And The Filter Of Specific Size Mxm By The Process Of Sliding Over The Input Image. The Output That Is Obtained Is Referred To As The Feature Map. As A Result Of The Output Image We Obtain Information About The Edges, And Corners .Later, We Study Several Other Characteristics Of The Input Image That Is Fed To Other Layers Using The Feature Map. In Most Of The Cases The Pooling Layer Comes Next To The Convolution Layer. The Ultimate Outcome Of This Layer Is To Reduce The Rate Of Computation Which Is Achieved By Reducing The Size Of The Feature Map. This Can Be Carried Out By Decreasing The Connections Between The Layers, And They Can Unconventionally Run On Each Feature Map. Average Of The Elements In A Preconceived Size Image Section Can Be Calculated By Using Average Pooling. The Sum Pooling Is Usually Determined By The Overall Sum Of The Elements. The Weights And Biases Are Comprised By The Fully Connected Layer And It Also Consists Of Neurons. The Main Purpose Of This Layer Is To Build Connection Among Different Layers. The Layers Discussed Are Placed Prior To The Layer Producing The Output And Thus It Forms The Last Few Layers. The Input Images That Are Accumulated From Preceding Layers Are Compressed And Finally Given To The Fc Layer. The Mathematical Operations Take Place When The Flattened Vectors Go Through Some More Layers Of Fc. In This Stage The Process Of Classification Begins.

As The Below Is The Comparison Of The Accuracy Of The Diseases That Are Obtained By The Model Implemented Using Convolutional Neural Network. As In The Existing System Only One Of The Eye Diseases (Either Macular Edema, Glaucoma) Is Identified Using Various Classifiers. But In Our Proposed Method We Have Used Cnn Algorithm As Both Feature Extractor And Classifier And Also It Obtains The Accuracy Of 100%.

1.

ACCURACY	EXISTING SYSTEM (%)	PROPOSED SYSTEM (%)
Macular Edema	90	100
Glaucoma	96.2	100
Diabetic Lesions	-	100

Fig 9 Comparison Of Existing And Proposed System.

Xi Output Images:

The Below Images Are The Result Of The Model As It Receives The Image Form The Database And Upload Them Into The Model Will Lead To The Identification Of The Eye Disease And Classify Them According To The Information Obtained From The Trained Data. Thus The Below Images Define The Accuracy Graph And Provide The Output Indicating The Identification Of Eye Disease Based Upon The Input Rgb Image.

(I)Glaucoma

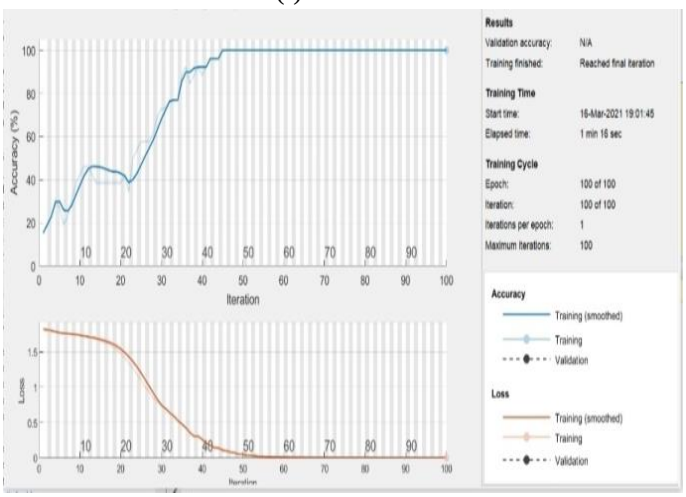

Fig 10 Accuracy Graph

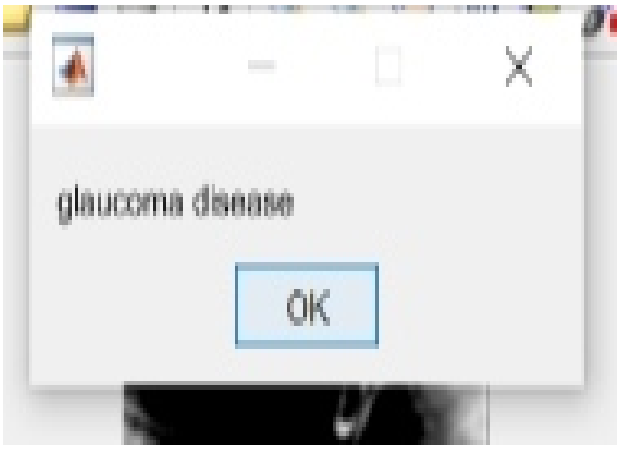

Fig 11 Classification

(Ii) Edema:

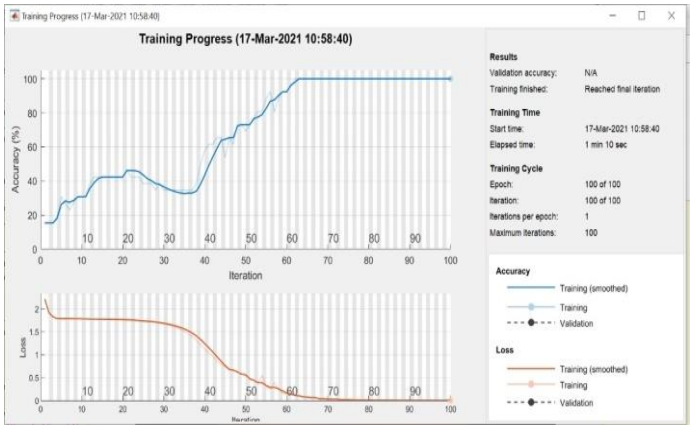

Fig 12 Accuracy Graph

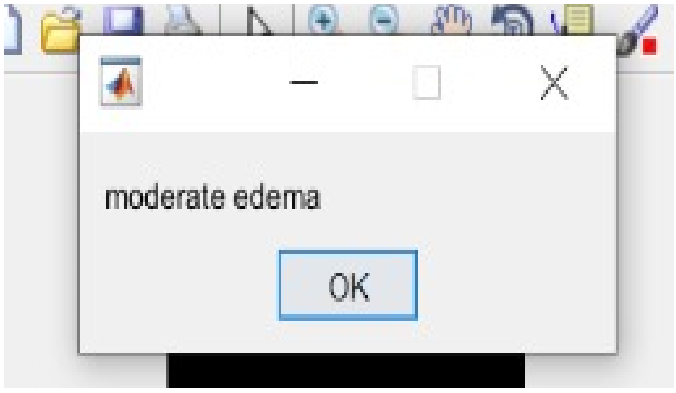

Fig 13 Classification

(Iii) Diabetic Lesions :

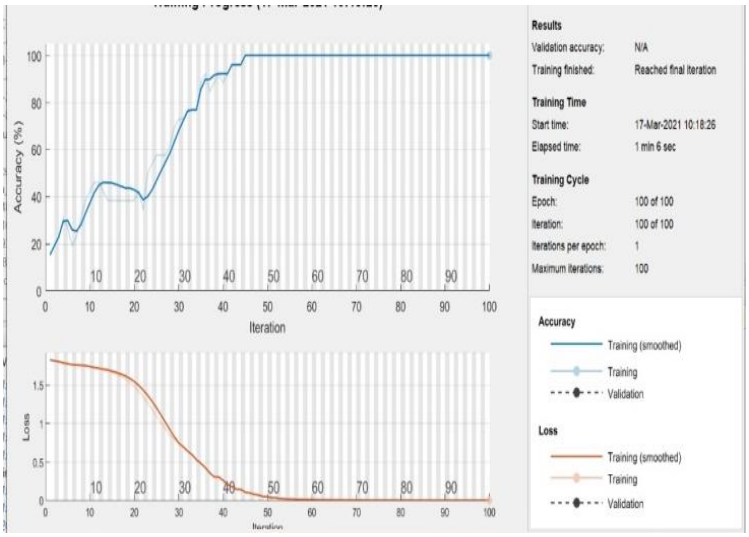

Fig 14 Accuracy Graph

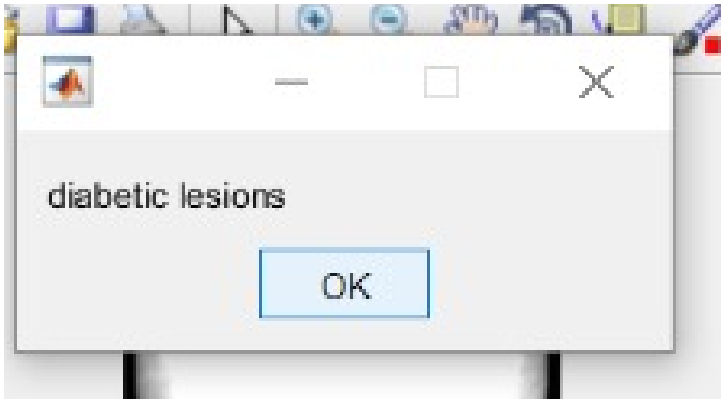

Fig 15 Classification

Xii Conclusion

In This Paper ,We Have Proposed A Deep Learning Method For The Classification Of The Eye Disease Namely Macular Edema , Glaucoma ,Diabetic Lesions Using Convolutional Neural Network .Our Approach Mainly Is To Detect The Type Of Disease As Mention Earlier And Also Classify Them As Healthy, Moderate And Severe By Training The Images From The Dataset Of Messdior And Testing .As It Applies The Method Of The Layers Of Softmax Layer It Obtains The Probability Of The Image And Provide The Maximum Probability Thus It Help In The Feature Extraction .Thus It Provides The Accuracy Of The Trained And Testing Images And Helps In The Fast Detection Of Type Of Eye Disease.

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