AI, ML and the Eye Disease Detection

Tian Jipeng[1], Suma P.[2], Dr. T.C.Manjunath[3]

[1]*Professor, Dept. of Computer Science & Engineering, No. 41, Zhongyuan Road (M), Zhongyuan University of Technology, Henan, China*

[2]*M.Tech. Post Graduate Student in VLSI Design & Embedded Systems (USN : (1DS18LVS11) @ ECE Dept. of Dayananda Sagar College of Engg., Bangalore, Karnataka, India.*

[3]*Prof. & Head of ECE Dept. of Dayananda Sagar College of Engg., Bangalore, Karnataka, India.*

***Abstract** : In this paper, a brief introduction to AI, ML and the Eye w.r.t. Deep Learning for Glaucoma Detection and Hardware Implementation is being presented. The result is the outcome of the Post-Graduate project work of the student that is going to be carried out in the second year of the course & this work is just the synopsis that is being framed for the carrying out of the detection of glaucoma disease.*

Keywords — *Glaucoma, AI, ML, Data Analytics, Eye*

I. INTRODUCTION

Glaucoma damages the optic nerve which leads to permanent blindness. It cannot be cured, so detecting the disease in time is very important. Glaucoma is one of the most severe eye diseases according to the number of blindness causes in India and western countries and is the second most leading eye disease. Therefore, the early detection, long-term monitoring of the patients and the decision about the appropriate therapy at the correct time are the serious tasks for the ophthalmologist.

Figure 1. Progressive visual loss caused by glaucoma. (a) Normal vision. (b) As glaucoma advances, the field of vision of a patient slowly narrows. (c) Advanced glaucoma without proper treatment leads to substantial vision loss, and to blindness if left untreated.

II. TYPES OF GLAUCOMA

Open-Angle Glaucoma: It is the most common form of glaucoma, accounting for at least 90% of all glaucoma causes & is caused by the slow clogging of the drainage canals, resulting in increased eye pressure it has a wide and open angle between the iris and cornea it develops slowly and is a long life condition its symptoms and damages are not noticed. Open-angle means that the angle where the iris meets the cornea is as wide and open as it should be Open-angle glaucoma is also called primary or chronic glaucoma.

Angle-Closure Glaucoma: It is a less common form of glaucoma & is caused by blocked drainage canals, resulting in a sudden rise in intraocular pressure it has a closed or narrow angle between the iris and cornea Develops very quickly it has symptoms and damage that are usually very noticeable Demands immediate medical attention. It is also called acute glaucoma or narrow angle glaucoma. Unlike open-angle glaucoma, angle-closure glaucoma is a result of the angle between the iris and cornea closing.

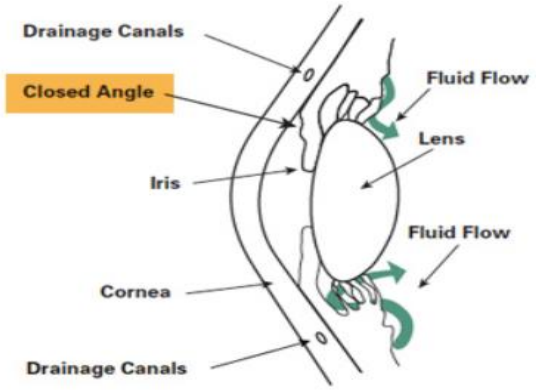

Figure 2. (a) Open-Angle Glaucoma. (b) Angle-Closure Glaucoma

III. DATA FLOW DIAGARM FOR GLAUCOMA DETECTION IN HUMAN EYES

Glaucoma is one of the common causes of blindness. It is a chronic eye disease that leads to vision loss, in which the optic nerve is progressively damaged. As the symptoms only occur when the disease is quite advanced, glaucoma is called the silent thief of sight. Although glaucoma cannot be cured, its progression can be slowed down by treatment. Early detection of glaucoma based on effective images is highly needed.

Digital Fundus Image is one of the main and popular modalities to diagnose glaucoma. Since it is possible to acquire DFIs in a non-invasive manner which is suitable for large scale screening, DFI has emerged as a preferred modality for large-scale glaucoma screening. In a glaucoma screening program, an automated system decides whether or not any signs of suspicious for glaucoma are present in an image. Only those images deemed suspect by the system will be passed to ophthalmologists for further examination.

Glaucoma diagnosis in the clinical environment involves intraocular pressure measurement, visual-field testing or optic disk examination on fundus images. Even though intraocular pressure is an indication of glaucoma, its measurement is not an effective way of glaucoma diagnoses as some patients with glaucoma may have normal eye pressure. Visual-

field testing, on the other hand, requires special equipment that some clinics may not have. The last method, optic disk examination, is more convenient than the other two and is more widely used by specialists for early glaucoma detection.

The generic automated glaucoma detection process is illustrated in Fig. 3.

In glaucoma detection first of all image of retina is taken using digital image capturing devices. Then preprocessing is required for equalization of irregularities with images. Feature extraction involves simplifying the amount of resources required to describe a large data set accurately. A feature is a significant data that can be used for classification. Classification refers to the analysis of the properties of an image. Depending upon the analysis, the dataset is further referred into different classes i.e. normal or glaucoma effected.

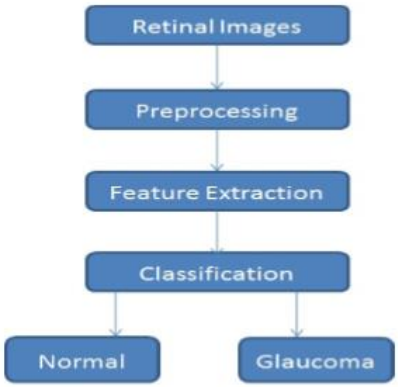

Fig. 3. Generic Process for Automated Glaucoma Detection

IV. DESIGN METHODOLOGY USING CNN

CNN is a state of the art method, because of its ability to extract features in images without complex pre-processing, coupled with transfer learning and fine-tuning parameters. This study uses VggNet, Alexnet, InceptionNet, GoogleNet ,and Resnet, which are transfer learning often used in deep learning. We use transfer learning to get the feature vector for classifying diabetic retinopathy using SVM and compare the results, which transfer learning is the best for classifying diabetic retinopathy. The classification layer is removed, and the last fully connected layer is applied to get the features for the classification process using the support vector machine (SVM) as shown in Fig.3

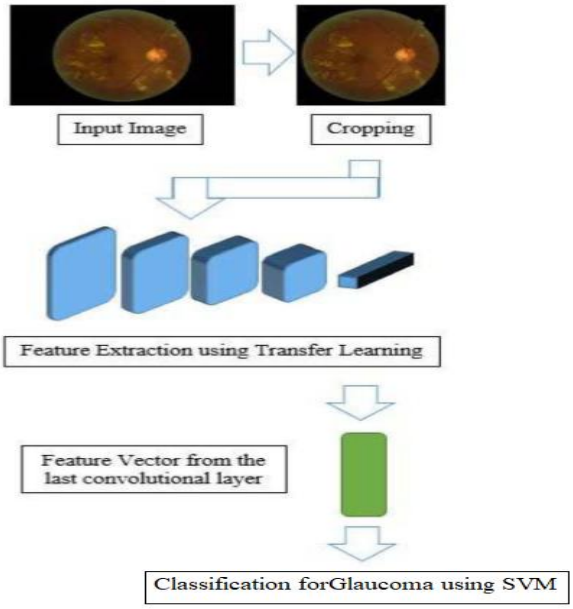

Fig. 4. Proposed method design

A CNN architecture generally consists of convolutional layers, pooling layers or subsampling layers, fully connected layers, and the classification layer as shown in Fig.4.

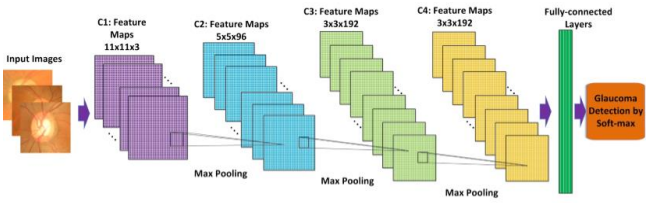

Fig. 4. An example of general CNN architecture.

V. CONCLUSIONS

As multimedia data is growing exponentially, more advanced techniques are needed to handle such huge amount of unstructured data. In this project, we study the advantages of utilizing deep learning techniques detect glaucoma using fundus images. The DL framework for glaucoma is implemented using deep convolutional neural networks such as AlexNet , GoogLeNet , VGG , ResNet and DenseNet. DL, a burgeoning technology of ML, has the ability to discover intricate structures in data sets without the need to specify rules explicitly. A DL network is an CNN with multiple layers between the input and output layers. It has dramatically improved the state-of-the-art in image recognition.

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Dr. T.C. Manjunath was born in Bangalore, Karnataka, India on Monday, the 6th of Feb. 1967 & received the **B.E. Degree** (Bachelor of Engg.) from the Karnataka's No. 1 Engg. College - **R.V. College of Engg**. (**Bangalore Univ**., Karnataka, India) in the year **1989**, **M.E.** (Master of Engg) **degree** in **Automation**, **Control & Robotics** from the prestigious 75-year-old Govt.'s **LD College of Engg**., (**Gujarat Univ**., Ahmedabad) in the year **1992** and **Ph.D.** in **Systems & Control Engineering** from the prestigious **Indian Institute of Technology Bombay** (**IIT Bombay**) in the year **2007** respectively.

He has got a teaching (academic), research & administrative experience of nealry **32+ years** in various engineering colleges all over the country (Karnataka, Gujarat, Maharashtra) and spent his entire career after graduation in the field of academics only. He has worked in the levels of **Lecturer-Asst. Prof**. (≈19+ yrs), PG Coordinator, Prof-i/c HOD-**Prof. & Head** (≈6+ yrs), **Director-Research**, i/c Principal & as Full time **Principal** (≈7 yrs) in various institutions where he has worked so far across the country. Currently, he is working as **Professor & Head of the Dept. of Electronics & Communication Engg.** of the renowned 40-year-old Dayananda Sagar Group's **'*Dayananda Sagar College of Engineering*'** in Bengaluru, Karnataka, India since **4 years** (approx). He has also worked as a **Project Assistant** and as a **Research Engineer** in the **Systems and Control Engineering** (**IIT Bombay**, India) and worked on vibration control of space launch vehicles in **IITB** during his research tenure for a period of nearly one year under the central government assistantship programme.

He has published a large number of papers in various National, International Journals and Conferences in India & abroad and published more than a **dozen textbooks** with editions, notable among them being ('***Introduction to robotics***' - 1st edition, '***Fast Track to Robotics***' - 4th Edn., '***Fundamentals of Robotics***' in 2 volumes, Vol-1 and Vol-2 along with a CD which contains about 200 C / C++ programs for performing various simulations on robotics – 5th edition, '***Examination Security System - Design & Development of Examination Mechanism Using Electronic Box***' from Germany costing around **49 Euros**, '***Microcontroller & Applications Theory***'-1st Edn, '***Basic Electronics'***-1st Edn). He has also published a number of '***book chapters***' in various edited books from renowned publishers (20 nos). He has also published a **research monograph** in the International level from the Springer-Verlag publishers (Europe) on the topic titled, "***Modeling, Control & Implementation of Smart Structures***", Vol. 350, LNCIS, costing €114.39 Euros, which was a collaborative work done in IIT Bombay.

He is a member of **30 professional societies** across the world. Some of them are …. a member of IEEE for the past 17 years (currently Sr. Member of IEEE), Sr. member of IIIEM, SPIE student member (USA) and IOP (USA) student member for 4 years, life member of ISSS-IISc (India), life member of additive manufacturing society of India (LMAMSI), Institute of Scholars (InSc), life member of the ISTE (India), life member of ISOI (India), life member of SSI (India), life member of the CSI (India), Life member of IMAPS, Sr. Member of IACST (Singapore) and life member cum fellow of the IETE (India), AMSI, Life member of IAENG, Life member of Inspira Research Assocaition, Chartered Engineer from IE (I) and a Fellow of the Institution of Engineers (FIE), Member of ACDOS - Automatic Control & Dynamic Optimization Society, Member of ACCS-Advanced Computing & Communications Society. He was also an EC & GC member of the IETE (Bangalore) for 2 years.

He has **given** (delivered) **a number of guest lectures / invited talks / expert talks and seminars** in many institutions across the length & breadth of the country and participated (attended) in more than **5 dozen** CEP / DEP courses, seminars, workshops, symposiums (with certificates), besides conducting a few courses in the institutions where he worked. He was awarded with the "**Best research scholar award** in engineering discipline" for the academic year 2006-07 for the entire institute from the Research Scholars Forum (RSF) from **Indian Institute of Technology Bombay** (**IITB**). This award was presented in recognition of the significant contribution to the research (amongst all the researchers in all disciplines) in IIT Bombay, where he published 29 research papers (***all of them were referreed ; 1-monograph from springer, 14 Journals-all refereed & free journals-abroad,*** 14 conferences). He is also a Sr. Typing (First Class with Distinction) specialist from the commerce institutes association of karnataka and a United Nations certified candidate along with 82nd position in the tenth standard merit list all over Karnataka. He is also an Hindi-Rastrabhasha (DBHPS) holder.