INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

PROPOSED ARCHITECTURE FOR DIABETIC RETINOPATHY DISEASE OF BLINDNESS USING DEEP LEARNING AND IMAGE PROCESSING

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ABSTRACT

Diabetic Retinopathy (DR) is one of the major causes of blindness in the western world. Increasing life expectancy, indulgent lifestyles and other contributing factors mean the number of people with diabetes is projected to continue rising. Regular screening of diabetic patients for DR has been shown to be a cost-effective and important aspect of their care. The accuracy and timing of this care is of significant importance to both the cost and effectiveness of treatment. If detected early enough, effective treatment of DR is available, making this a vital process. The diagnosis of diabetic retinopathy (DR) through colour fundus images requires experienced clinicians to identify the presence and significance of many small features which, along with a complex grading system, makes this a difficult and time consuming task. As it is a leading disease in the west, there needs to be an easy solution and way to identify the disease. We, through this app are trying to do the same and help in some real world problem of the society. We propose a CNN approach to diagnosing DR from digital fundus images and accurately classifying its severity. We develop a network with CNN architecture and data augmentations which can identify the intricate features involved in the classification task such as micro-aneurysms, exudates and hemorrhages on the retina and consequently provide a diagnosis automatically and without user input. We train this network using a high-end graphics processor unit (GPU) on the publicly available Kaggle dataset and demonstrate impressive results, particularly for a high-level classification task. On the data set of 80,000 images used our proposed CNN achieves a sensitivity of 95% and an accuracy of 75% on 5,000 validation images. What should be no surprise in an image recognition task, most of the top contestants used deep convolution neural networks (CNNs), and so did we. Our solution consisted of multiple steps:

1. Image preprocessing
2. Training multiple deep CNNs
3. Eye blending

Through this project we have tried to curb and make a prevailing problem of the society that is Diabetic Retinopathy disease easier to deal with.

Keywords: *Eye blindness, CNN, Deep Learning, Image Processing, Dr. DRE*

I. INTRODUCTION

DRE stands for Diabetic Retinopathy Epidemiology. Diabetic Retinopathy (DR) is one of the major causes of blindness in the western world. Increasing life expectancy, indulgent lifestyles and other contributing factors mean the number of people with diabetes is projected to continue rising. Regular screening of diabetic patients for DR has been shown to be a cost-effective and important aspect of their care. The accuracy and timing of this care is of significant importance to both the cost and effectiveness of treatment. If detected early enough, effective treatment of DR is available, making this a vital process.

Diabetic retinopathy (DR) is a leading cause of vision-loss globally. Of an estimated 285 million people with diabetes mellitus worldwide, approximately one third have signs of DR and of these, a further one third of DR is vision-threatening DR, including diabetic macular edema (DME). Many people who are affected by by DR cannot get the screening done and thus there is a need to develop computer algorithms that could screen a retinal image for diabetic retinopathy, thereby making readings faster, more cost-effective, and potentially more accurate. We, through this app are trying to do the same and help in some real world problem of the society.

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difficult and time consuming task. As it is a leading disease in the west, there needs to be an easy solution and way to identify the disease. We, through this app are trying to do the same and help in some real world problem of the society. We propose a CNN approach to diagnosing DR from digital fundus images and accurately classifying its severity. We develop a network with CNN architecture and data augmentations which can identify the intricate features involved in the classification task such as micro-aneurysms, exudates and hemorrhages on the retina and consequently provide a diagnosis automatically

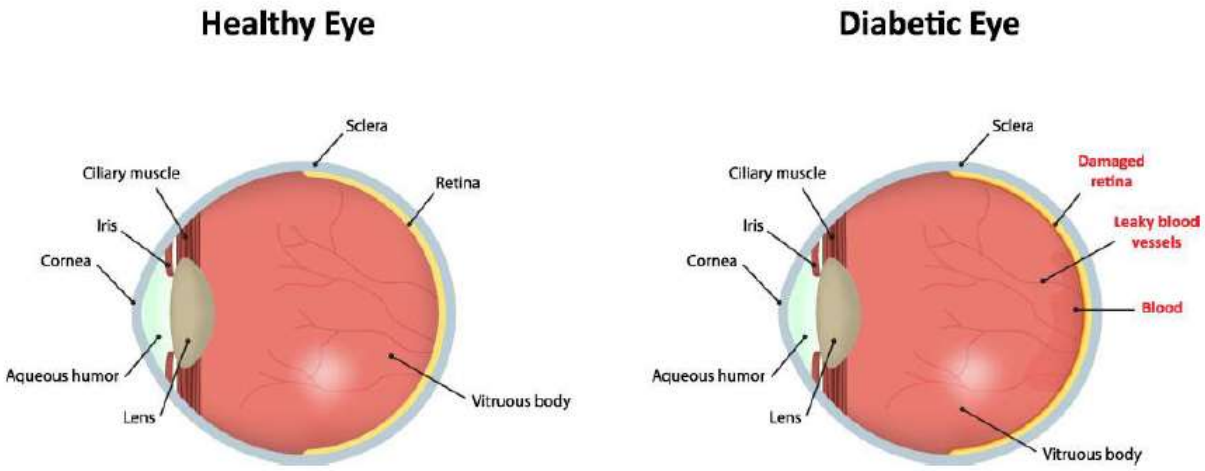

Figure 1: Comparison of Eye having DR and not Having DR

II. PRODUCT PERSPECTIVE

The application will be mobile-based, connected over a network to display the result of the test performed through the output device. In this figure, the user system will send a request to the server. The application "Dr. DRE" is basically for the people who already are Diabetics patients and can also have Diabetics Retinopathy (DR). In this application a user will have to use his/her Android phone's camera and a 20D lens to take an image of the fundus of the patient. Then the image will be further processed and cleaned and then will be sent to the server and then sent through the classifier where it will be decided whether the patient suffers from DR or not. Then finally the result will be displayed to the end user.

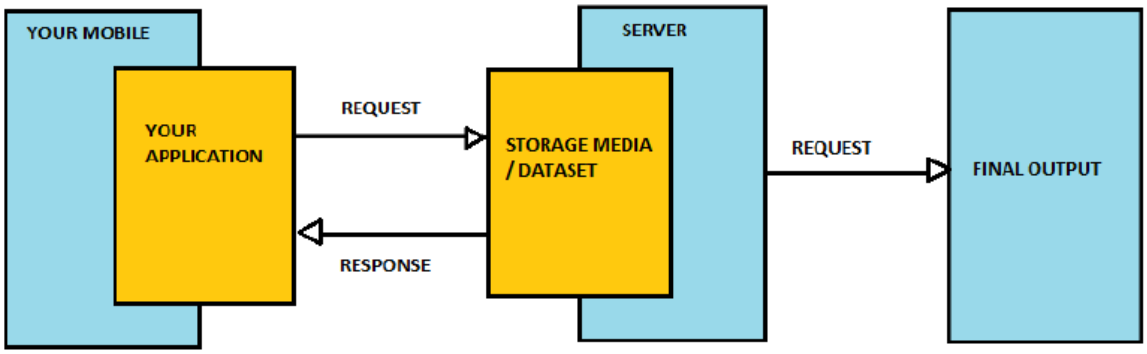

Figure 2: Request-Response Architecture

III. PROPOSED METHODOLOGY & ANALYSIS MODEL

We propose a CNN approach to diagnosing DR from digital fundus images and accurately classifying its severity. We develop a network with CNN architecture and data augmentations which can identify the intricate features involved in the classification task such as micro-aneurysms, exudates and hemorrhages on the retina and consequently provide a diagnosis automatically and without user input. We train this network using a high-end graphics processor unit (GPU) on the publicly available Kaggle dataset and demonstrate impressive results, particularly for a high-level classification task. The application "Dr. DRE" is basically for the people who already are Diabetics patients and can also have Diabetics Retinopathy (DR). In this application a user will have to use his/her Android phone's camera and a 20D lens to take an image of the fundus of the patient. Then the image will be further processed and cleaned and then will be sent to the server and then sent through the classifier where it will be decided whether the patient suffers from DR or not. Then finally the result will be displayed to the end user

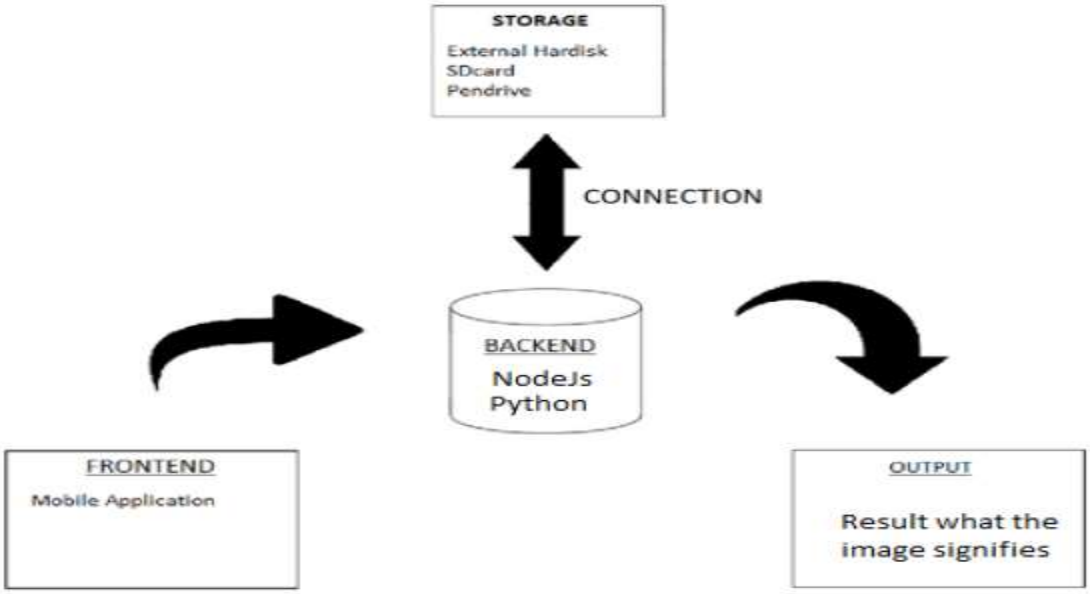

Figure 3: Proposed Architecture

The functioning of the product is divided into two sections:

- ❖ Application functioning
- ❖ Analysis

❖ **Application**

The application will act as a user interface for the whole system; inputs would be given through the application. This interfacing can be done through touch inputs

The image of the eye will be taken by and then it will be preprocessed after which it will be sent to the server and then a classifier which is coded in python is applied on the images so as to detect the result.

❖ **Analysis**

- Image recognition task using deep convolution neural networks (CNNs)
- Maintaining the data in the dataset so that the acquired image could be compared and then given the results.
- Detect the Diabetic Retinopathy in an efficient and cost-efficient manner.
- Let the user know about the doctors that could help in the case and give proper treatment.
- Let the diabetic patient know whether he is positive or negative for DR

IV. HARDWARE, SOFTWARE AND COMMUNICATION INTERFACE

A. Hardware Interface

- 20D lens: The most commonly used lenses are indirect, also known as “aspheric” and “condensing” lenses, which are classically used at a slit lamp—for example, 78D or 90D lenses—or with a head mounted binocular indirect ophthalmoscope (e.g., 20Dor 28D lenses).
- Camera: The camera of the phone will be required to take the image of the fundus of the patient’s eye.
- Network / Internet: The Internet is a global wide area network that connects computer systems across the world. It includes several high-bandwidth data lines that comprise the Internet "backbone."
- Storage disk: Disk storage (also sometimes called the drive storage) is a general category of storage mechanisms where data are recorded by various electronic, magnetic, optical, or mechanical changes to a surface layer of one or more rotating disks. A disk drive is a device implementing such a storage mechanism.
- Smart phone: a mobile phone that performs many of the functions of a computer.

B. Software Interface

Minimum system requirements:

- Android Studio: Android Studio is the official[6] integrated development environment (IDE) for Google's Android operating system, built on JetBrain’s IntelliJ IDEA software and designed specifically for Android development.
- Python 3.5 for the Classifier.
- Anaconda: Anaconda is a freemium open source distribution of the Python and R programming languages for large-scale data processing, predictive analytics, and scientific computing, that aims to simplify package management and deployment.
- Tensorflow: TensorFlow™ is an open source software library for numerical computation using data flow graphs. Nodes in the graph represent mathematical operations, while the graph edges represent the multidimensional data arrays (tensors) communicated between them.

C. Communication Interface

The product ‘Dr. DRE’ contains hardware devices which are 20D lens and camera of the phone that has the application installed. In this application a user will have to use his/her Android phone’s camera and a 20D lens to take an image of the fundus of the patient. Then the image will be further processed and cleaned and then will be sent to the server and then sent through the classifier where it will be decided whether the patient suffers from DR or not. Then finally the result will be displayed to the end user. We propose a CNN approach to diagnosing DR from digital fundus images and accurately classifying its severity. We develop a network with CNN architecture and data augmentations which can identify the intricate features involved in the classification task such as micro-aneurysms, exudates and hemorrhages on the retina and consequently provide a diagnosis automatically and without user input. We train this network using a high-end graphics processor unit (GPU) on the publicly available Kaggle dataset and demonstrate impressive results, particularly for a high-level classification task.

ISSN 2277 – 5528
Impact Factor- 4.015

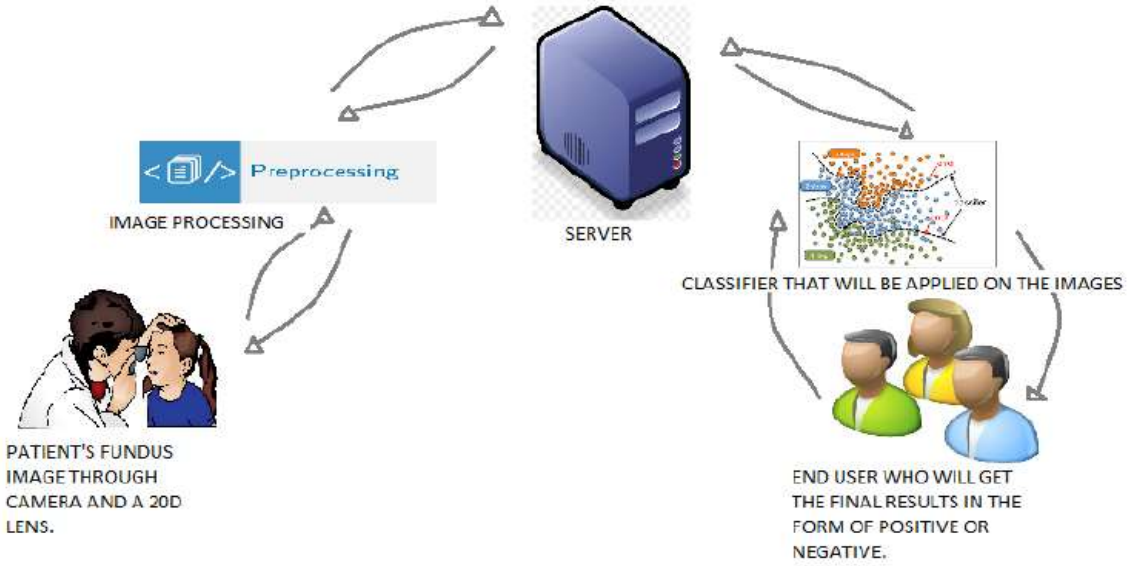

Figure 4: Process Flow of Dr. DRE

D. Sequence Diagram

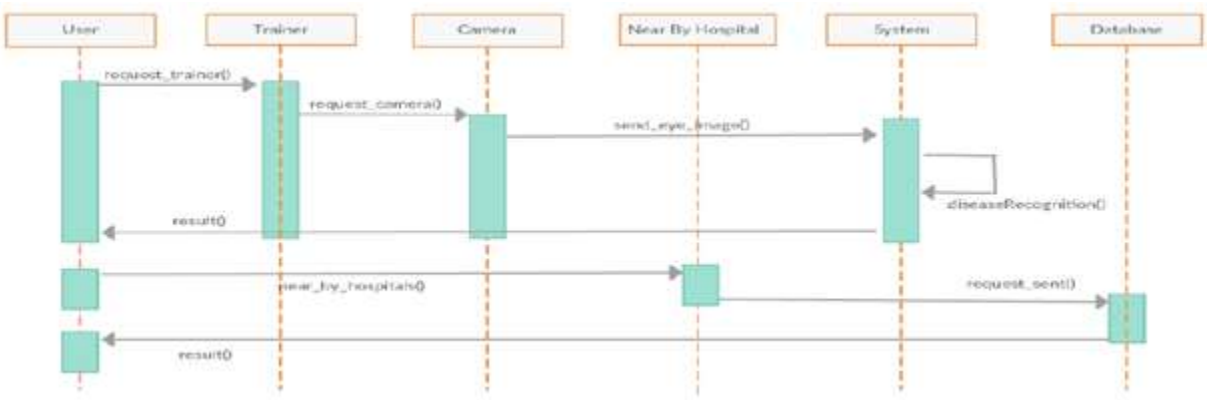

Figure 5: Sequence Diagram

E. Activity Diagram

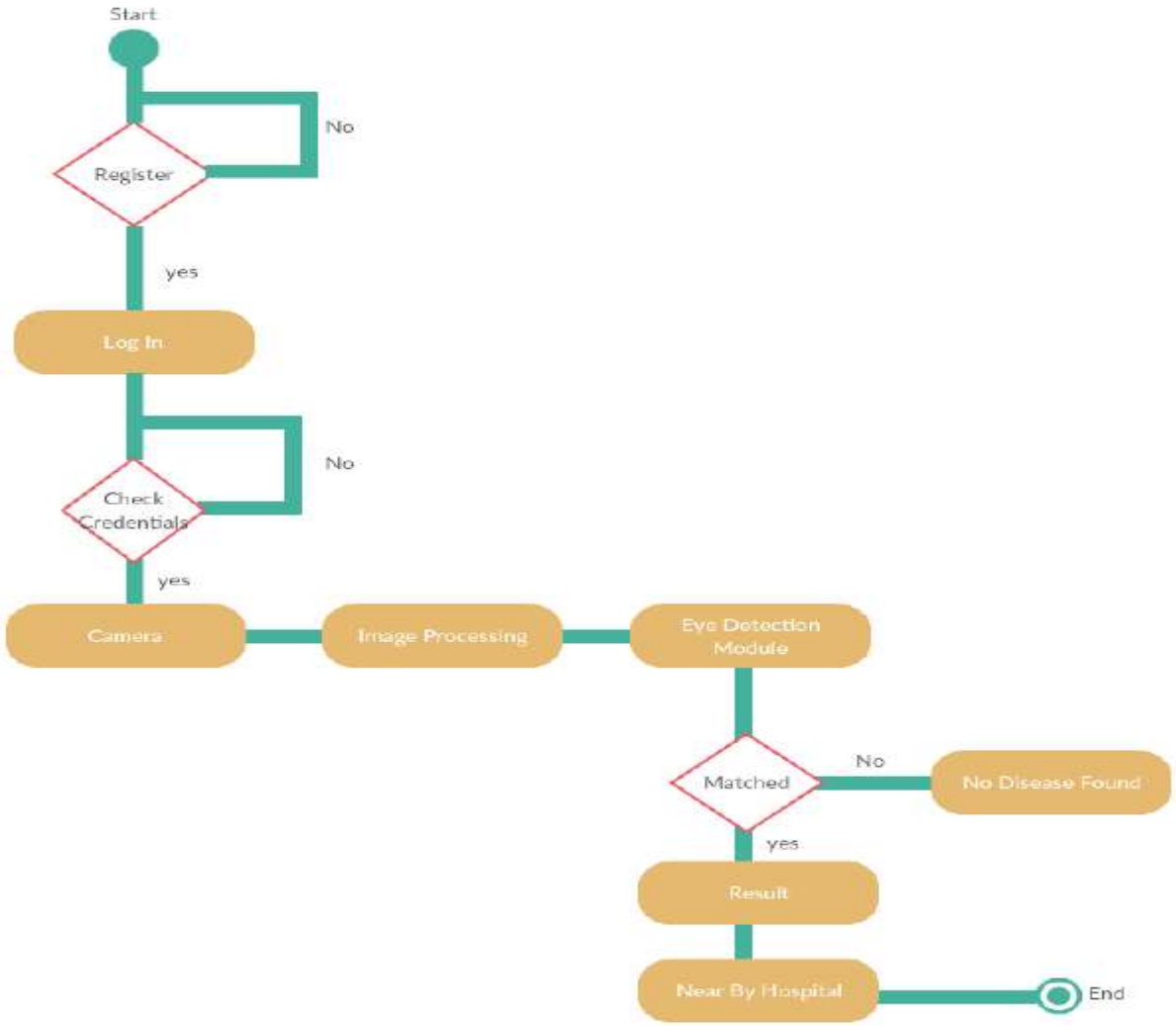

Figure 6: Activity Diagram

V. CONCLUSION

This is to conclude that the project that we undertook was worked upon with a sincereeffort. Most of the requirements have been fulfilled up to the mark and the requirementswhich have been remaining, can be completed with a short extension. As it is a leadingdisease in the west, there needs to be an easy solution and way to identify the disease. We,through this app are trying to do the same and help in some real world problem of the society

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