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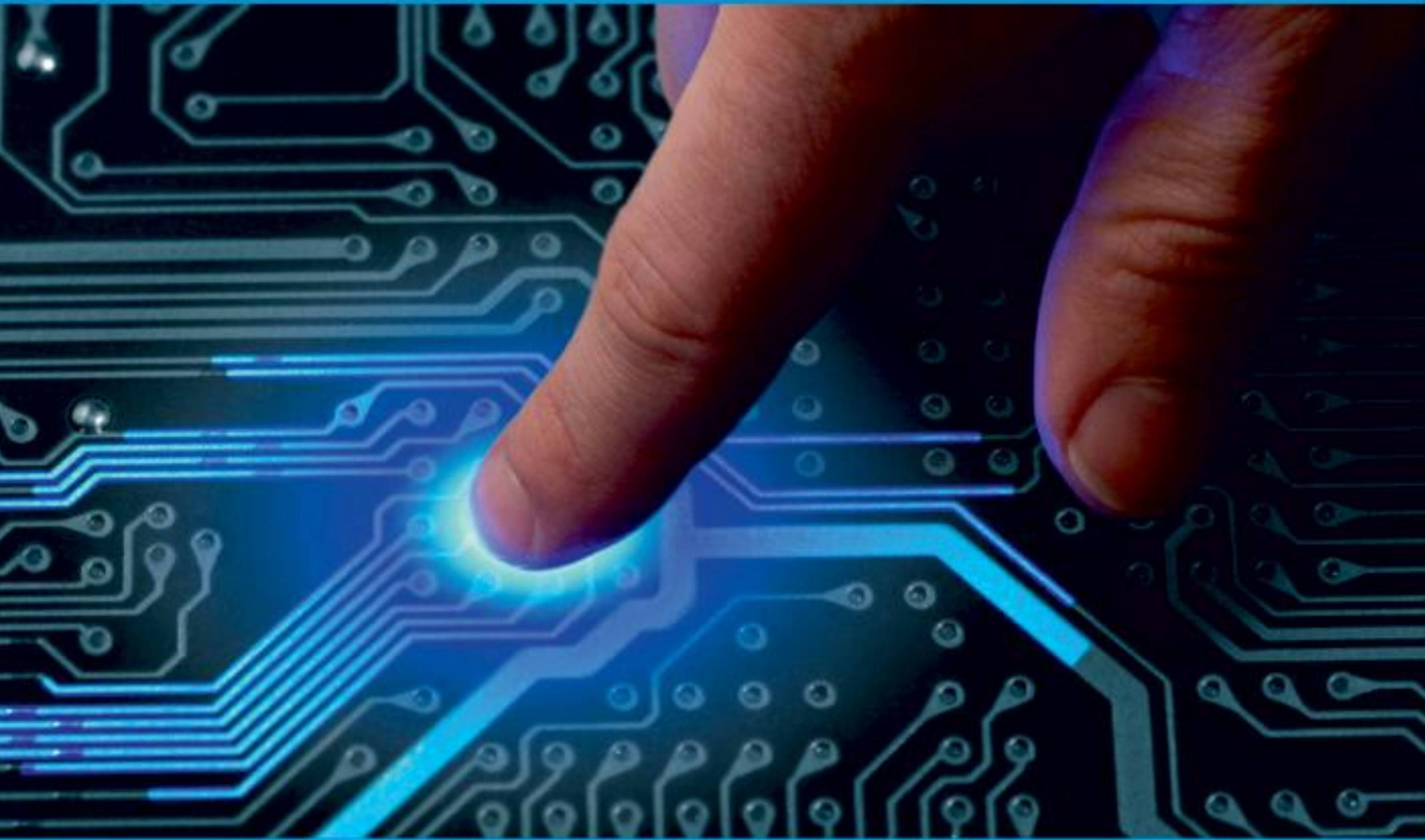

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Keratoconus Identification using CNN

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ABSTRACT: The cornea is the outer layer of the eye, the surface covering the front of the eye. The structural and repair properties of the cornea are essential for its function: protecting the inner contents of the eye, maintaining the shape of the eye, and achieving light refraction. The cornea is composed of proteins and cells and does not contain blood vessels, unlike most tissues in the human body. existence of blood vessels may affect its transparency, which in turn may affect the proper light refraction, hence worsening vision. Because there are no blood vessels that supply nutrients in the cornea, tears and aqueous humour provide nutrients to the cornea. cornea is composed of five layers: the epithelium, the Bowman's layer, the stroma, Descemet's membrane, and the endothelium. The first layer, the epithelium, is a cell layer that covers the cornea. This layer absorbs oxygen from tears and passes it to the rest of the cornea. The cornea also contains free nerve endings.

Keratoconus (KTC) is a noninflammatory disorder characterized by progressive thinning, corneal deformation, and scarring of the cornea. The pathological mechanisms of this condition have been investigated for a long time. In recent years, this disease has come to the attention of many research centres because the number of people diagnosed with keratoconus is on the rise. In this context, solutions that facilitate both the diagnostic and treatment options are quickly needed. The implementation of an algorithm that can determine whether an eye is affected or not by keratoconus. The KeratoDetect algorithm analyses the corneal topography of the eye using a convolutional neural network (CNN) that can extract and learn the features of a keratoconus eye. KeratoDetect can assist the ophthalmologist in rapid screening of its patients, thus reducing diagnostic errors and facilitating treatment. Both the genetic and environmental factors have been associated with the disease, but in recent years, a new theory emerges that keratoconus could also have an inflammatory component. However, since many patients with allergies rub their eyes excessively, it has not been clearly established whether eye rubbing is a factor related to the keratoconus pathology.

KEYWORDS: Cornea, Genetic,Keratoconus, Kerato Detect, CNN, Corneal Topography.

I.INTRODUCTION

The cornea is the outer layer of the eye, the surface covering the front of the eye. The structural and repair properties of the cornea are essential for its function such as protecting the inner contents of the eye, maintaining the shape of the eye, and achieving light refraction. The cornea is composed of proteins and cells and does not contain blood vessels unlike most tissues in the human body. The existence of blood vessels may affect its transparency, which in turn may affect the proper light refraction, hence worsening vision. Because there are no blood vessels that supply nutrients in the cornea, tears and an aqueous liquid provide nutrients to the cornea.

Keratoconus is a noninflammatory condition characterized by progressive thinning, deformation, and scarring of the cornea. The pathological mechanisms of keratoconus have been investigated for a long time. Both the genetic and environmental factors have been associated with the disease, but in recent years, a new theory emerges that keratoconus could also have an inflammatory component [1].
At early stages the Symptoms of Keratoconus are like those any of Refractive Defect of eye so early detection of disease is hard. However, since many patients with allergies rub their eyes extremely, it has not been ascertained whether eye rubbing is a factor related to the keratoconus pathology but can increase the cornea deformation [2]. Imbalance of enzymes within Cornea results in Weakening of corneal tissues which leads to Keratoconus. This imbalance makes more susceptible causing Cornea weakening and bulge forward.

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In this Paper, the image processing is performed first on the input cornealtopography image in which it is subjected to pre-processing to remove noise, followed by image enhancement, segmentation and feature extraction. The output of the image processing is fed to a Machine Learning algorithm. Here, we have used a CNN model to train and validate the data images.

II.RELATED WORK

Corneal topography is the primary diagnostic tool for keratoconus detection, and pachymetry data and corneal aberrations are also commonly used.For subclinical Keratoconus detection a combination of optical coherence tomography (OCT) and video keratography are used. Some automatic methods have been proposed to identify keratoconus from corneal maps, among these methods, neural networks have proved to be useful.
The Drawbacks are:

- Use of a single parameter of corneal tomography.
- Video keratography only examines the anterior surface of the cornea.
- Does not have diverse patterns.

III.OBJECTIVES

- The objective is to implement an algorithm able to determine the eye is affected by keratoconus or not.
- To pre-process and extract useful features from data.
- To train a Machine Learning Model on these extracted features.
- To integrate the model in the diagnostic process of an assistant software to help the ophthalmologist
- To evaluate model-performance and improve it.
- To perform hyper parameter tuning on components of model.

IV.PROPOSED SYSTEM

The methods to detect the keratoconus eye are less accurate and need more time. There is a need to develop and implement machine learning technique to early detection of keratoconus disease.

V.PROJECT MODULES

1.*Dataset Collection Module*

In this module, we collect the data and organize the dataset in required folder for reading image files using python. The collected dataset is the Corneal Topography images.

2.*Image Preprocessing Module*

We preprocess the image by converting them into standard sizes, converting them to tensors so that they are ready for CNN training.

3.*Building a CNN model Module*

Build custom CNN which can split the data set into train and test to extract features from the images and then we flatten the features so that they can be used along in the algorithm to classify the image.

4. *Evaluate the model Module*

The model is evaluated and saved after achieving the maximum accuracy and the saved model is used for classification.

5. *Login Module*

An interface is provided for the admin and ophthalmologist to login into their respective profiles. The admin controls the application whereas, the ophthalmologist looks into the aspect of test the corneal topography.

6. *Admin Data Maintenance Module*

Specifically designed for the admin, to add or remove ophthalmologist and access to view the details of the users.

7. *Patient Data Collection Module*

A module which allows the ophthalmologist to upload image and provides its prediction as output.

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VI. SYSTEM ARCHITECTURE

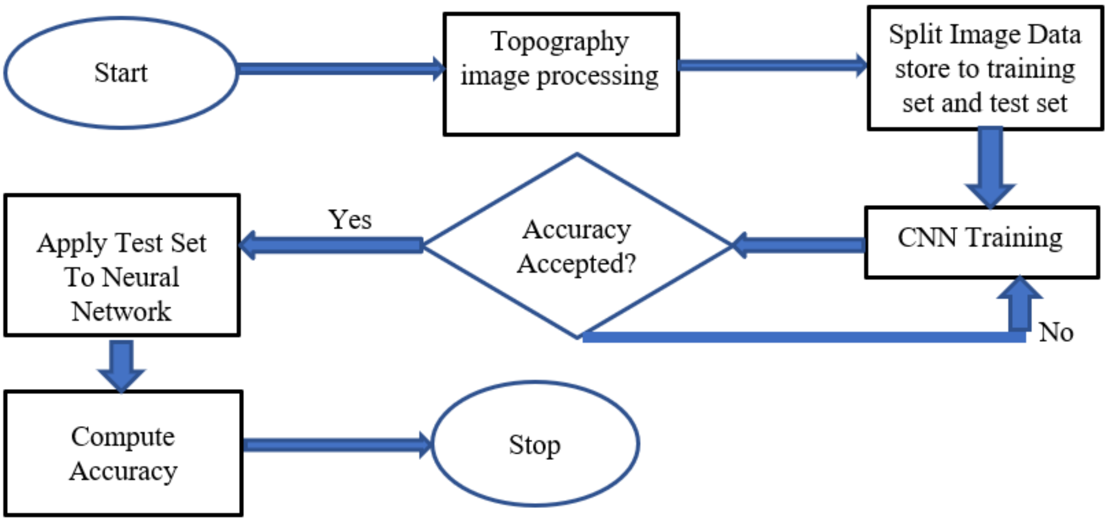

Figure-1 System Architecture

The architecture of the Identification of keratoconus Application. It mainly constitutes two blocks – Image processing and Machine Learning. In the Image processing, the corneal topography is given to the application as an input image, which is then resized to an appropriate size comprising the pre-processing phase.

In the machine learning block, the Convolutional Neural Network (CNN) is trained on the dataset to build the model and is then saved for later deployment. The pre-processed image is then provided to this model which classifies the image and predicts it as keratoconus or not keratoconus.

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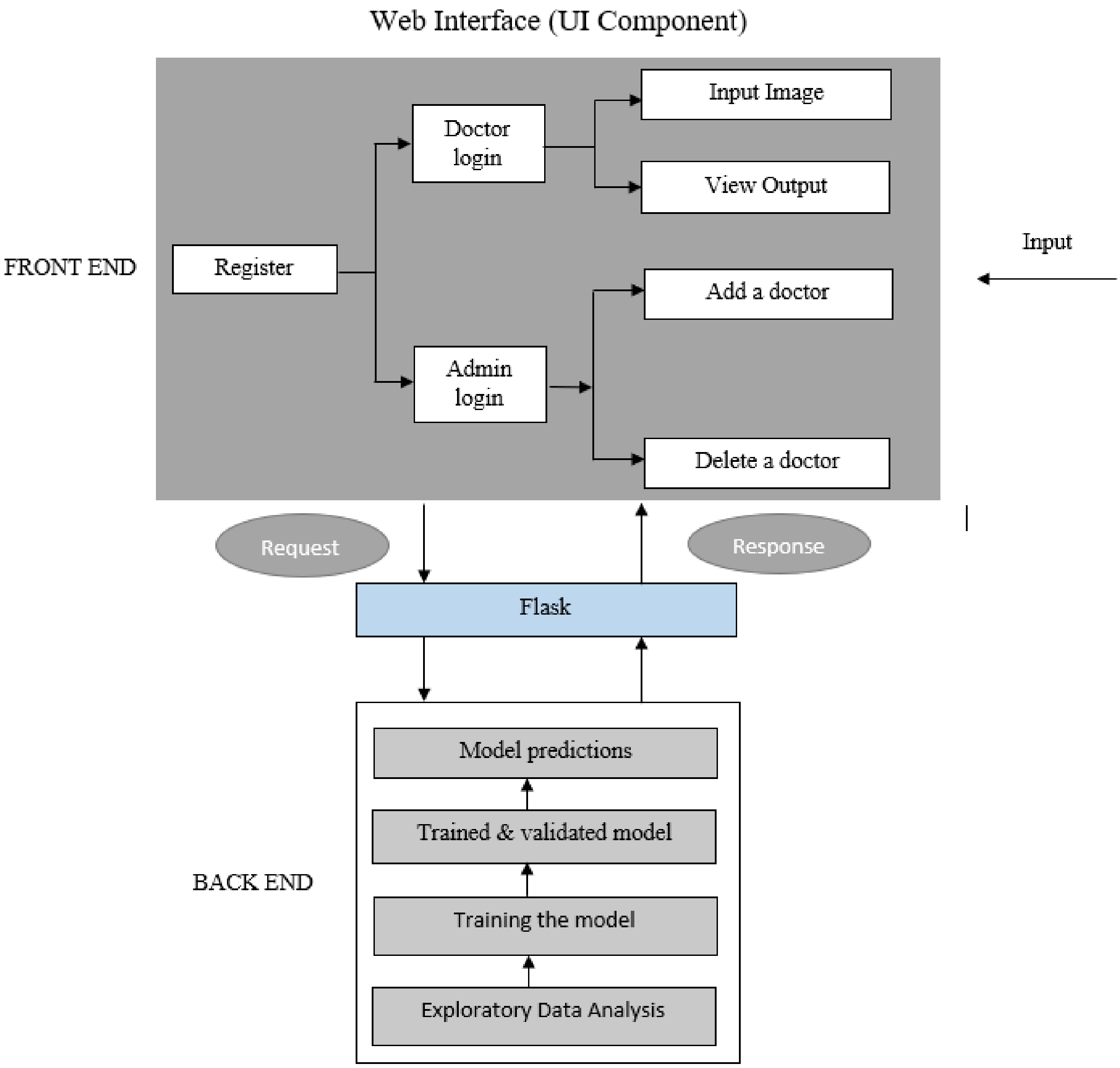

Figure-2 System Interface

The project is build using Python in backend and Flask to act as interface. The front-end functionalities of the interface design are user register, user login, upload topographic images and displaying the result. The back-end functionalities of the interface design are Keratoconus Identification Application, classification of test images and result prediction. The frontend is built using Html, CSS and JavaScript which sends HTTP requests to the Ingress Controller and gets data in response.

VII.ALGORITHM

- Main goal is to implement and test an algorithm that allows keratoconus detection by facilitating the diagnostic process. Algorithm uses a convolutional neural network (CNN). The most used modality to diagnose and confirm keratoconus is to make a corneal topography which is then interpreted by the ophthalmologist specialist. images will consider the input of KeratoDetect algorithm, within the learning process associated with the convolutional neural network (CNN).

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- The developed neural network processes the input data (e.g., pixel values of an image representing the corneal topography) using weights on connections between neurons. learning process involves the continuous adjustment of these weights to reduce the error in both the classification and learning processes.
- Many learning algorithms use multilayer networks between inputs and outputs. neural networks allow the identification of features, patterns, and characteristics within the classification relationship. Technological progress has led to the development and refinement of these algorithms, with them being used in many areas of medicine with confidence.
- In neural networks, convolutional neural network (CNN) is one of the main methods of recognizing and classifying images. CNNs are currently used in applications such as object recognition and face detection. A CNN that can diagnose the keratoconus disease is implemented in this paper.

VIII.PSEUDO CODE

STEP 1: Acquire the dataset images in specific form
STEP 2: Perform multiple pre-processing(image) from the Train and Validation set to enable efficient and accurate classification, for example Flip, Random_Rotate, Resize and others.
STEP 3: Configure the Custom CNN model to fit the current usage, Do
- Pass the required parameters like the filters, padding to be used

STEP 4: Define Hyper parameters -Batch size, Learning rate, Weight decay, Loss function, Number of epochs
STEP 5: For each epoch, Do
- Set the train mode and perform training step:
- Training step compares the output of the model with the target and computes the loss.
- Backpropagate in the network to adjust the weights.
- Set the train mode to false (validation mode):
- Get the model output and compare with the actual result. Compute the accuracy score.

STEP 6: Save the model.
STEP 7: Stop.

IX.RESULTS

In our model confusion matrix summarizes the test image set classification which are classified using saved trained CNN model. Out of 600 test images, 295 images areclassified as true positive, 5 images are classified as false positive, 1 image is classified as false negative and 399 images are classified as true negative. In figure 8.1, the symbol ‘0 in confusion matrix indicates Keratoconus eye category and the symbol ‘1’ indicates Normal eye category.

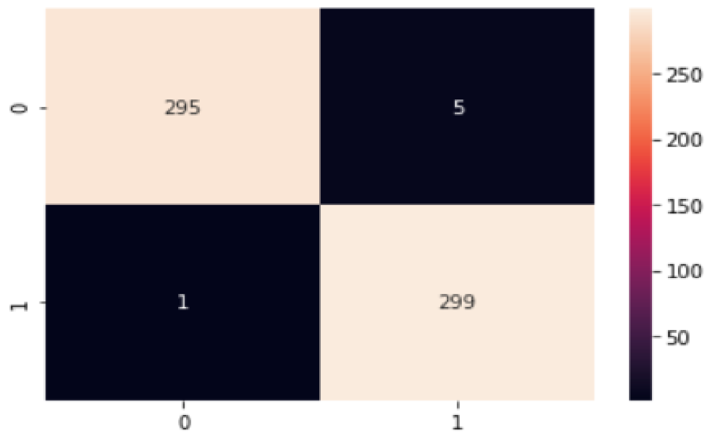

Figure-3Results

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X.CONCLUSION, APPLICATIONS AND FUTURE WORK

A.*Conclusion*

The main advantage of the proposed algorithm is that it can be used as an integrated part of the diagnostic process.Machine learning algorithms have the potential to interrupt classical medical screening programs, being able to provide diagnostics in a very short time as well as helping to increase patient care and comfort.In conclusion, this project presents the development of a screening tool based on a learning algorithm that automatically detects the keratoconus disease based on cornealtopography image

B.*Applications*

- Provides effective and efficient automated solution, which enables ophthalmologists to obtain fast, accurate and objective information on corneal haze.
- Enables researchers and practitioners to develop machine learning models.
- Application of machine learning method as standardized method of care for keratoconus detection of individual patients.
- KeratoDetect can assist the ophthalmologist in rapid screening of its patients, thus reducing diagnostic errors and facilitating treatment.

C.*Future Scope of the Project*

Further scope lies in using much more descriptive features to accurately predict the Keratoconus disease and provide Internet of Things (IoT) solutions that can alert the patients about their diagnose report. To Making the Project patient-centric for the patient to access his health history, medication history etc.

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