

**Proposal for**

**Final Year Project**

**Computer & Information Systems Engineering Department**

**“AI Enable DR Diagnosis FYP 2021”**

**DUA E FATIMA**

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## 1. Project Identification

1. **Reference Number** (for office use only)

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1. **Project Title**

AI enabled DR screening and reference system

1. **Project Internal Advisor**

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1. **Project Internal Co-Advisor**

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1. **Project External Advisor**

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## F. Student Team

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1. **Sponsoring Organization** (if any)

Shahzad Eye hospital

1. **Keywords**

Artificial Intelligence, Machine learning, Computer Vision, Data Augmentation, Deep Learning, Convolutional Neural Network, Diabetic Retinopathy, Image-data, Retina, Fundus images, Portable device, Android application

1. **Project Idea**

“Diabetic retinopathy is a condition in diabetes caused by high blood sugar levels - damaging the back of the eye (retina), which leads to vision loss if not diagnosed on time. For treatment of this issue, we should diagnose this efficiently. There are some rural areas where technologies could not make their ways till now. But the disease is increasing rapidly and to control this issue an early diagnosis is sufficient. To capture the retinal images or to do diabetic screening it requires high performance fundus camera and machine, which is too huge and costly and could not make it to commute at different places. To minimize this issue, we are going to make a device which is portable. So that we can use it as a gadget and can take it to different places for the screening purpose. To execute this task, we are going to design a system software will can be installed in android phone. This system software will be based on artificial intelligence and machine learning. Which will do classification of computer vision related problem with data augmentation technique and algorithm. But to carry out this task, an unbalanced dataset of samples is available. Thus, a technique that balances the datasets will be proposed, which provides efficient and accurate results in the end. Hence, the data augmentation technique will balance the provided unbalanced datasets on which we will train a low-cost machine learning model that can be operational on gadgets easily. The ophthalmologists will find it quite helpful to do DR diagnosis using this technique. The proposed and trained model is usable on ophthalmologist devices easily. Thus, there will be no need for big setups to locate from one place to another. Because after augmentation of the unbalanced dataset, the diagnosis can be performed simply by mobile phones. To evaluate the performance of the AI algorithm in detecting any grade of DR using retinal images captured from patients with diabetes mellitus. The AI diagnosis system works using Convolutional Neural Networks. Performing Image processing on images before feeding the images to the neural networks. Lastly, developing an app to deliver the software to the public. Where ophthalmologists can use the app to get an alert if diagnosed of a deteriorating condition of higher grade - consult the specialist as soon as possible. This condition of diabetic retinopathy is worsening day by day. Therefore, immediate attention is must, to tackle the spreading disease.”

Fig 1.

## 2. ABSTRACT

“Diabetic retinopathy is a disease that spreads gradually over a time span of several years among diabetic patients. Although it does leads to blindness butt it can be treatable if diagnosed early. However heavy machinery is something that cannot be accommodate everywhere, whereas this approach is not economic friendly as well. To overcome this challenge an easy, portable and cheap device is required. In this project our aim to design a device that can perform diabetic retinopathy screening through a portable device. This device will have a software that perform the classification task, comprises and developed on artificial intelligence and machine learning concepts. An algorithm with the help of a suitable model will be designed which would be able to by itself identify if a designated diabetic patient is suffering from Diabetic Retinopathy. Dataset to make this algorithm will be collected then pre-processed and augmented. Further broken down into different testing and training phases to best train our model.”

## A. Project Background and Literature Review

“Diabetic retinopathy (DR) is the most common complication of diabetes mellitus (DM). It has long been recognized as microvascular disease. Wie Wang [1] in his study told us that the majority of patients failed to achieve clinically significant visual improvement. Therefore, there is an urgent need for the development of new treatments. Simó-Servat O. [2] in his paper tells us that the main risk factors are disease duration, poor glycaemic control, and the presence of hypertension. However, there is an important variation in risk which indicates that other factors, such as genetic heritability or glycaemic variability, play an important role in accounting for the susceptibility to DR development. Uzair Ishtiaq and his team [3] proposed the technique in the field of artificial intelligence for which he writes, due to the advancements in artificial intelligence, early detection of DR through an automated system is more beneficial than manual detection. This study presents a review on DR detection techniques from five different aspects namely, datasets, image pre-processing techniques, machine learning-based approaches, deep learning-based approaches, and performance measures. The Artificial Neural Network was a proven eminent classifier compared to other machine learning classifiers. In deep learning, Convolutional Neural Network outperformed compared to other deep learning networks. Four researchers in 2018 proposed that [4] Three hundred and one patients with type 2 diabetes underwent retinal photography with Remidio ‘Fundus on phone’ (FOP), a smartphone-based device, at a tertiary care diabetes centre in India. Grading of DR was performed by the ophthalmologists using International Clinical DR (ICDR) classification scale. STDR was defined by the presence of severe non-proliferative DR, proliferative DR or diabetic macular oedema (DME). The retinal photographs were graded using a validated AI DR screening software (EyeArtTM) designed to identify DR, referable DR (moderate non-proliferative DR or worse and/or DME) or STDR. The sensitivity and specificity of automated grading were assessed and validated against the ophthalmologists’ grading. In this paper [5] they have written about IDx-DR. IDx-DR is a software program that uses artificial intelligence (AI) with convolutional neural network models to analyze retinal images taken with the Topcon TRC-NW400, a fully automated nonmydriatic retinal camera designed to obtain high-resolution colour images of the retina and the anterior segment of the eye. It is approved by the U.S. Food and Drug Administration for diabetic retinopathy screening in adults 22 years and older with diabetes mellitus The pilot study results show promise in the use of an offline AI system in community screening for referable diabetic retinopathy with a smartphone-based fundus camera. The use of AI would enable screening for referable diabetic retinopathy in remote areas where the services of an ophthalmologist are unavailable. This study was done on patients with diabetes who were visiting a dispensary that provides curative services to the population at the primary level. A study with a larger sample size may be needed to extend the results to general population screening, however. Thus far, a variety of studies, researches, and tests have been performed on the grade’s detection of diabetic retinopathy. As proved by the given citations. Yet, very little is done in the data augmentation of the unbalanced data to achieve more accurate results. This project’s main milestone will be to achieve a better data augmentation technique to balance the data sets available.”

## B. Motivation and Need

“It has been perceived that diabetic retinopathy is increasing and its effects are damaging the health of many. Thus, deep research is needed to identify the gross condition at the first place. As many patients go undetected and suffer the perils of the disease, especially in the rural areas. Medical field is one among the fields that need immediate attention and using technology to detect, research and cure the diseases, which have kept humanity their victims since the world’s inception. There is no proper screening available in Pakistan. All DR algorithms work on heavy machines. Thus, we will propose such a technique in which even on small mobile phones these algorithms will work. Easing the work of ophthalmologists. In this era of revolutionizing world, its high time now to revolutionize the medical field."

## 3. Objectives

* To design a portable device for DR screening and develop system software that perform DR screening.
* Data Pre-processing will be performed on collected dataset to clean our real-world data into an understandable form.
* Data augmentation technique to meet the need of balance data availability for the algorithm.
* To devise an algorithm with a reliable network accuracy for the detection of level of test Diabetic Retinopathy.
* To convert our research into an app so that ophthalmologists can use it easily.

## 4. Methodology and Equipment/Tools

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## 4A. METHODOLOGY

Diabetic retinopathy) is a diabetes complication that affects eyes. It's caused by damage to the blood vessels of the light-sensitive tissue at the back of the eye (retina). At first, diabetic retinopathy might cause no symptoms or only mild vision problems. But it can lead to blindness. To treat this disease expensive treatments are available which everyone cannot afford easily. An algorithm will be designed along with appropriate model that will tell whether the patient has diabetic retinopathy or not. Dataset to make this algorithm will be collected and further preprocessing steps and augmentation will be applied. Lastly the model will undergo training and testing phase to achieve the best outcome.



**Android Application for Automatic DR Model.**

**Input**

**Pre-processing**

**Model**

**Final Result**

s

Fig 2.

## 4B. TOOLS

* TensorFlow, Keras, PyTorch, NumPy, Pandas
* Android Studio

**AUTHENTICATION:**

We will break the dataset into three parts; training, testing and validation. Performed on the unknown dataset to calculate the accuracy and efficiency of its results with the help of confusion matrix parameters a mobile application will be made.

**SYSTEM MODULE:**

Real world datasets will be collected from the hospital, they will be pre-processed and augmented into a balanced form. A model will be created to diagnose a Diabetic Retinopathy patient with the most accurate results. To achieve this target the datasets will be trained on the created model until it is capable enough of reading the fundus images and giving an appropriate result. Once the model is finalized a mobile application will be built so that anyone who has a high-resolution camera lens on their mobile phone can click an image and run it through the model to check their results. This application will work offline so internet access won’t be necessary either.

## 5. Key Milestones and Deliverables

|  |  |  |  |
| --- | --- | --- | --- |
| **No.** | Elapsed time (in months) from start of the project | **Milestone** | **Deliverables** |
| 1 | 1 month | Literature Review | Methodology and dataset selection for AI model training |
| 2 | 2 months | Data Collection | Collection of Data |
| 3 | 3 months | Data pre-processing | Pre-Processed Dataset |
| 4 | 4 months | Data Augmentation Algorithm for Images | Balanced Dataset |
| 5 | 5 months | Different model will be trained CNN variants on proposed technique. | To achieve highly efficient model |
| 6 | 6 months | Evaluation of Trained Model | Trained Model |
| 7 | 7 months | Test on real world Dataset | Tested Dataset |
| 8 | 8 months | Building a user-friendly Mobile Application. | Android App for detecting DR |
| 9 | 10 months | Working on Report | Report |

## Expected Outcome

An application that diagnosis the human eye with the help of specific type of lens then compare with the collected dataset and will result us whether the penitent has diabetic retinopathy or not. Whether it is treatable or required immediate assistance etc. This user-friendly application cannot use the camera lens of mobile phones since they are not of high resolution to capture the fundus images. Only a doctor can use this app with the help of a special lens needed to take detailed images. In simplified form, broken down in four different tasks following are the outcomes of this project:

* Identify the best Data augmentation technique to resolve class unbalancing of local Dataset.
* Visualization/Comparison of Augmented Data/Real Data.
* Train any CNN architecture using balanced Dataset to achieve the best outcome.
* Simple low weight mobile app for diagnosing DR; based on ML algorithm.

## 6. Direct Customers / Beneficiaries of the Project

* Diabetic Patients
* Ophthalmologists

## 7. Consent of Advisors

**Consent of the Internal Advisor** Signature:

**Consent of the Co-Internal Advisor** Signature:

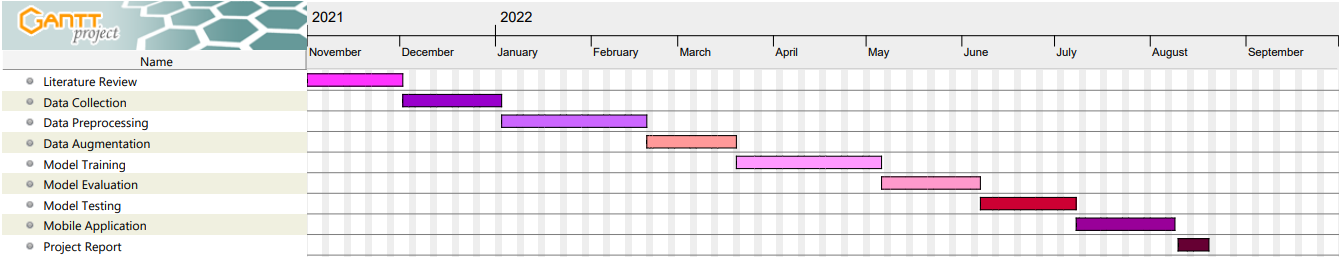
**Consent of the External Advisor (if any)** Signature:

## 8. Reviewers Committee’s Comments

**9. Project Schedule / Milestone Chart**

**AI Enable DR Diagnosis Sept 30, 2021** **chart** 3

**Gantt chart**



## 10. Project Approval Certificate

**Recommendation of FYP Coordinator** Signature:

**Approval by the Chairman** Signature:

**REFERENCES**

[1] Wang, Wei, and Amy CY Lo. "Diabetic retinopathy: pathophysiology and treatments." International journal of molecular sciences 19.6 (2018): 1816

[2] Monserrat, Olga, Cristina Hernández, and Rafael Simó. "Diabetic retinopathy in the context of patients with diabetes." Ophthalmic research 62.4 (2019): 211-217.

[3] Ishtiaq, Uzair, et al. "Diabetic retinopathy detection through artificial intelligent techniques: a review and open issues." Multimedia Tools and Applications 79.21 (2020): 15209- 15252.

[4] Rajalakshmi R, Subashini R, Anjana RM, Mohan V. Automated diabetic retinopathy detection in smartphone-based fundus photography using artificial intelligence. Eye (Lond). 2018 Jun;32(6):1138-1144. doi: 10.1038/s41433-018-0064-9. Epub 2018 Mar 9. PMID: 29520050; PMCID: PMC5997766.

[5] Grzybowski, Andrzej, et al. "Artificial intelligence for diabetic retinopathy screening: a review." Eye 34.3 (2020): 451-460.