DIAGNOSIS OF DIABETIC RETINOPATHY USING DEEP LEARNING ALGORITHMS

Supported by KSCST - 46th Series Student Project Programme [Ref: 7.1.01/SPP/33]

Project Proposal Reference No. : 46S_BE_0561

Project Synopsis 2022 - 23

PROJECT PROPOSAL FOR SPP INNOVATION PROJECT
[46th SERIES OF STUDENT PROJECT PROGRAMME]

Submitted to

KARNATAKA STATE COUNCIL FOR SCIENCE AND TECHNOLOGY

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by

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1. INTRODUCTION

1.1 DIABETIES

Diabetes mellitus, commonly referred to simply as diabetes, is a disease that causes high blood sugar. One of the most prevalent diseases, diabetes, is becoming more prevalent all over the world. It is primarily linked to the body's excessive blood sugar levels and insulin production, which leads to abnormal metabolic processes and problems including cardiovascular illnesses, kidney failures, neurological disorders, and diabetic retinopathy (vision loss), among others. A serious eye illness called diabetic retinopathy causes permanent vision loss that should be prevented or treated at the early stage. No matter if a person has type 1 or type 2 diabetes, the likelihood of developing the condition rises with age.

1.2 DIABETIC RETINOPATHY

Diabetic retinopathy is a serious complication of diabetes that affects the eyes. It occurs due to damage to the blood vessels in the retina, the light-sensitive tissue at the back of the eye. Early recognition and diagnosis play a crucial role in preventing the progression of diabetic retinopathy to severe stages and ultimately preventing vision loss and blindness. By identifying and addressing diabetic retinopathy at its early stages, healthcare professionals can implement appropriate interventions and treatments to manage the condition effectively and improve patient outcomes.

1.3 MOTIVATION

- Research shows that it contributes around 5% of total cases of blindness, WHO estimates that 347 million of world population is having the disease diabetics and about 40-45% of them have some stage of the disease.
- There are various factors affecting the disease like age of diabetics, poor control, pregnancy, but research shows that if we can detect DR in early stage of the disease progression to vision impairment can be slowed or averted.
- So, the aim of our project is to provide an automated and sophisticated model using deep learning technique we can detect DR at early stage easily so that damage to retina can be minimized.

1.4 OBJECTIVES

- Our objective is to pre-process the human retinal images to detect the presence of diabetic retinopathy and classify its severity level.
- Process colour fundus retinal images and extract key features from the pre-processed images for Diabetic Retinopathy detection.
- Detect the presence of Diabetic Retinopathy.
- Contacting Specialised doctors and getting feedback, and guidance for affected persons.
- Communicating with patients in remote/rural areas through SMS alert with doctor description for prevention.

2. METHODOLOGY

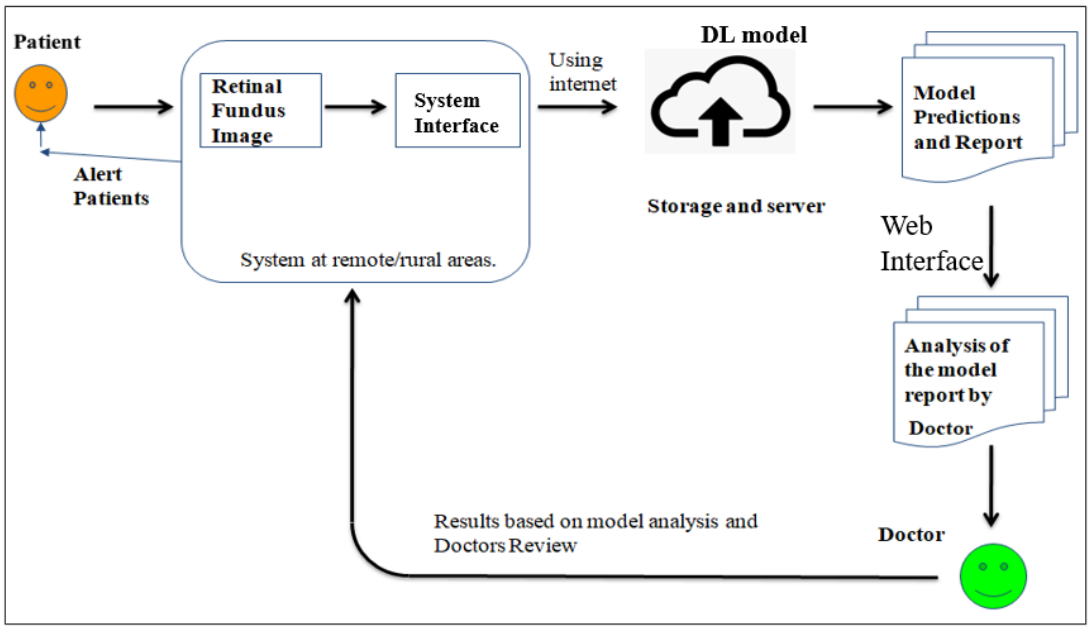


Figure 2.1 – System Architecture

The following details the many steps used as part of the suggested technique.

- Using a fundus camera to capture the patient's retinal picture, uploading via a website that connects DL models kept in the cloud with a technician's assistance at a system or computer for processing.
- The trained DL as illustrated below in training model. The cloud-based model receives the raw input image and goes through various fundamental processes, such as pre-

processing, to produce the needed image. Predictions and a thorough report will be produced.

- For rural areas which have small dispensaries and can afford a fundus camera, but don't have expert medical professionals available. A device that enables clinicians to rank instances according to the seriousness of the condition. For anyone who wants to make healthcare affordable and accurate in remote areas.
- The findings from the DL model are kept and results are forwarded to a specialist doctor, who does a comprehensive study of the model predictions and provides feedback to the patient and technician to explain the situation.
- The same feedback and description are sent through SMS alert to patients.

2.1 IMPLEMENTATION

The implementation phase is divided into two parts shown below.

PART-A: DL PREDICTION MODEL

i. Developing a Trained Model:

The process involved in the training model follows with some steps:

- Data Acquisition
- Data Pre-Processing
- Data Augmentation
- Model Development

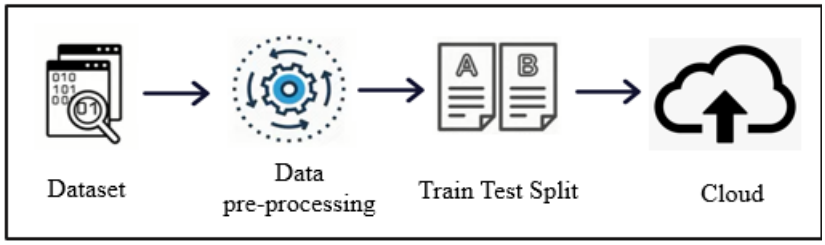


Figure 2.2 - Process Involved in Training Model

ii. Web Page Prediction Model:

Python's model.py file from the Flask application framework can be used to add deep learning models for prediction. The model.py file can accept input data from users or external sources. After any necessary preprocessing, the data should be fed into a trained deep-learning model for inference.

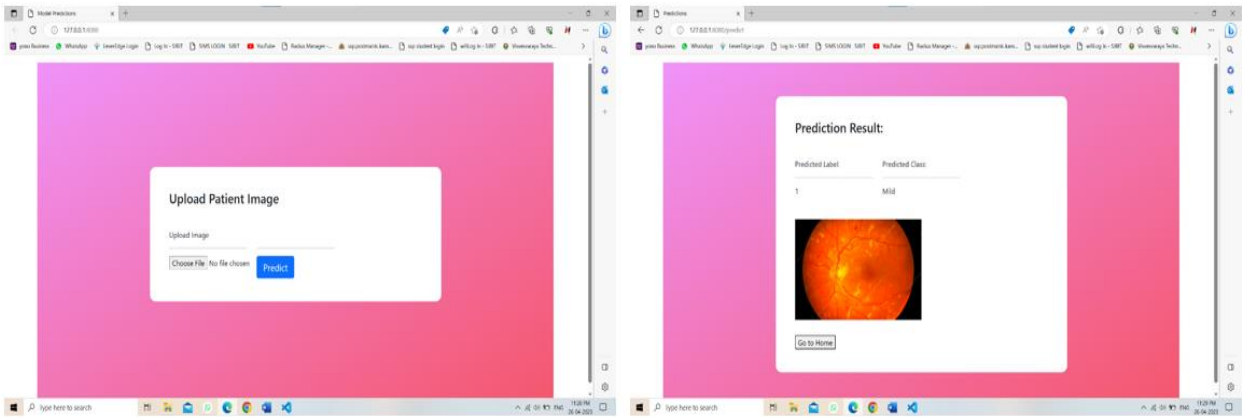


Figure 2.3 - Model Prediction Web Page

PART-B: WEB INTERFACE

In a healthcare context, an interface that links admin and doctors can help to improve interactions and exchanges of data between these two groups. This interface may provide features like appointment scheduling, patient data management, and secure messaging, allowing administrators and doctors to work more efficiently together when providing patient care and monitoring patients.

Web interface involves the following pages.

- Home Page
- About Page
- Contact Page
- Login Page

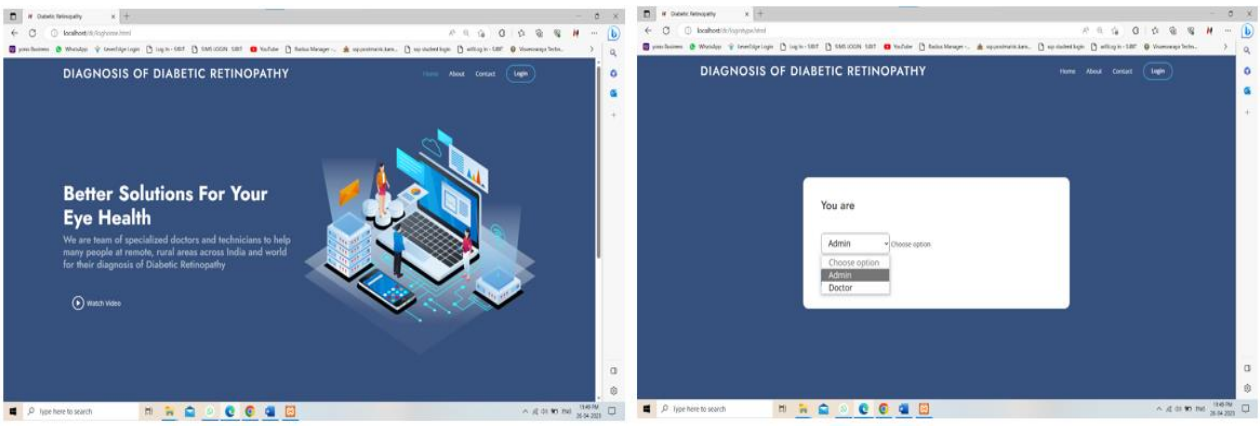


Figure 2.4 – Web Interface Page

i. Admin Page:

The admin can administer many components of the system from the Admin Home Page, which acts as a central center. A wide range of options are available, including managing patient

records, updating doctor information, and sending SMS messages.

STEP 1: Utilize the New Registration Form on this page to register a new patient. The DR database will be stored with all information.

STEP 2: The patient retinal picture upload webpage in the second step enables the admin to upload results of model predictions of their patients with the Registration number to the website.

STEP 3: The My Registrations homepage shows a patient's name, age, registration number, medical history, and any feedback given by their doctor, in addition to other basic information. Patients can quickly access and review their medical records, monitor their progress.

STEP 4: Using the website's SMS Sending Page, administrators can send SMS messages to patients.

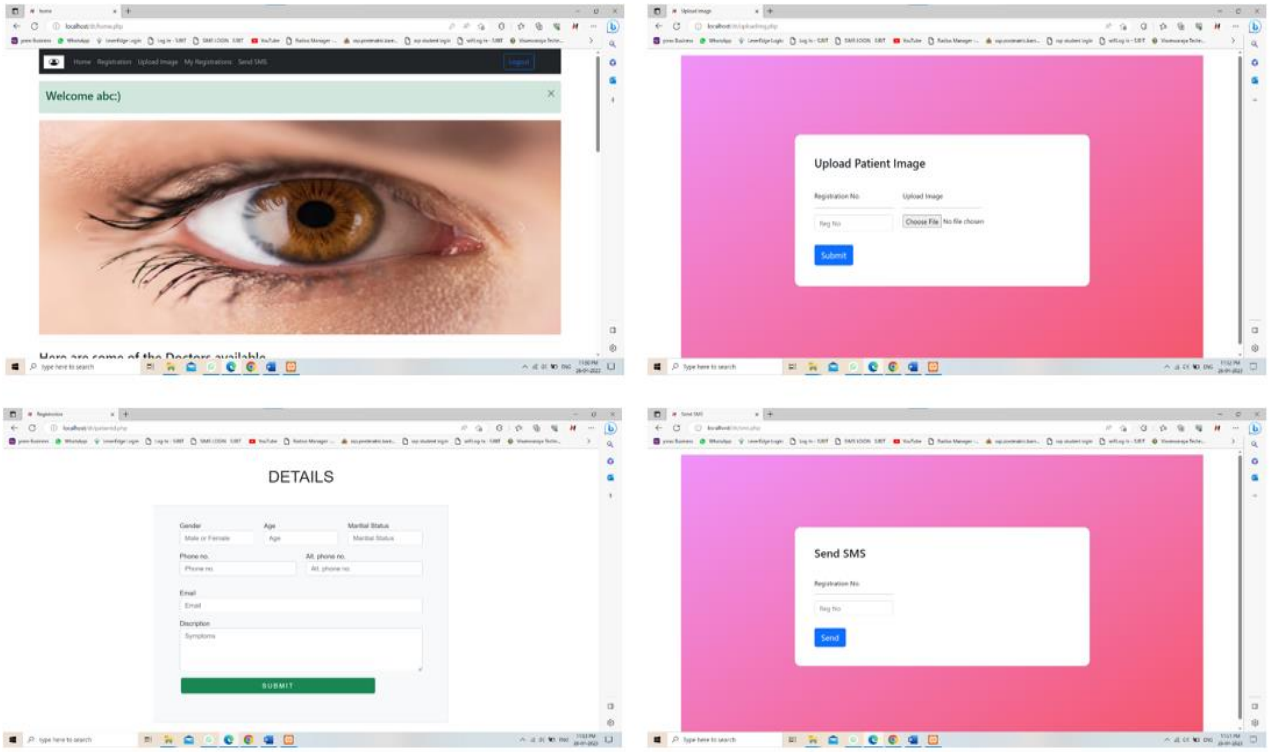


Figure 2.5 - AutoCAD Design for Laser Cutting

ii. Doctors Page:

Doctors can check patient registrations and make certain updates to their personal information on the Doctors Home Page. Doctors can manage their patient load and maintain their information updated on this page simply and safely. Doctors need the View Registration and Feedback Updating Page to successfully manage patient care. Additionally, the page enables physicians to comment on a patient's condition, and the feedback is updated in the patient's record on the My Registrations page so that admin can see it.

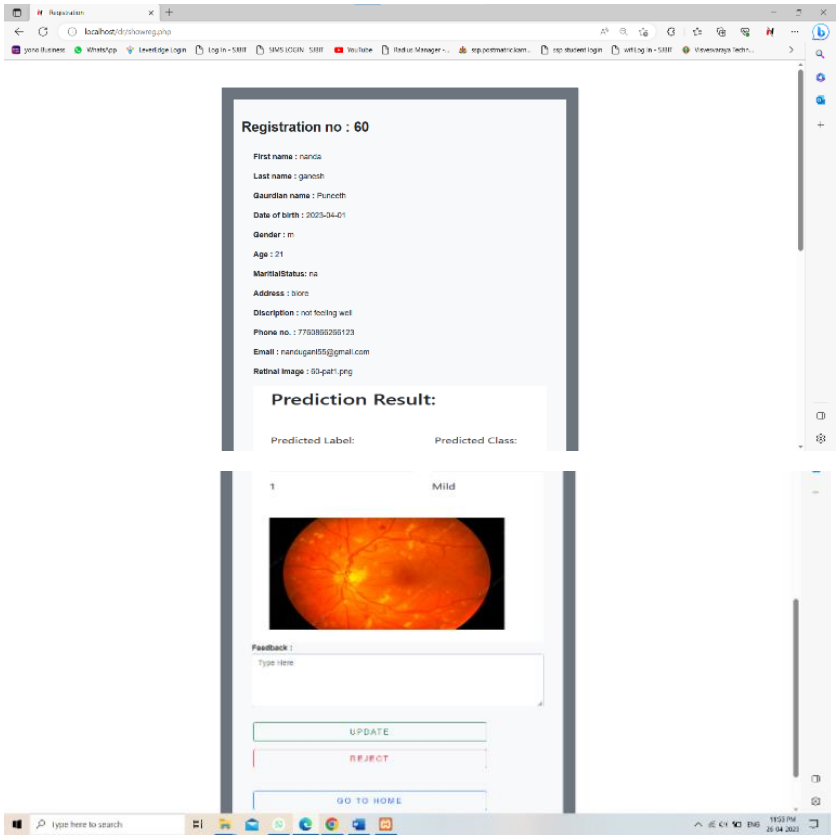
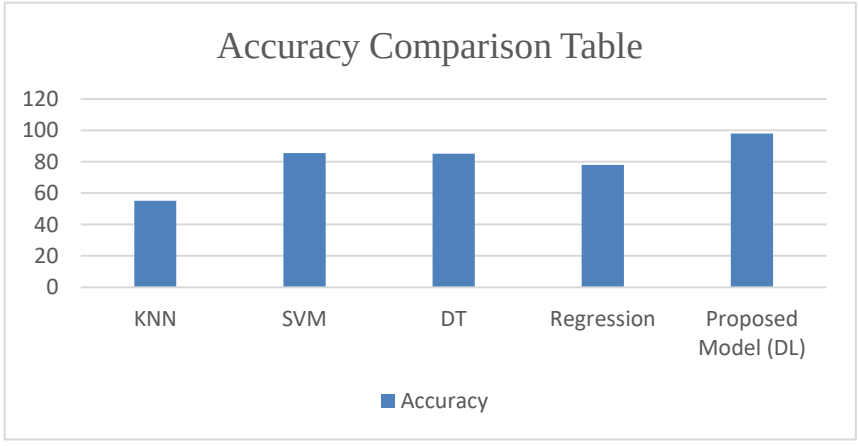


Figure 2.6 - View Registrations and Feedback Updating Page

RESULT AND DISCUSSION

We combined a dataset from Kaggle's APTOS 2019 blindness detection with ResNet-152 to train our suggested model, and the outcome has an accuracy of 0.984. A variety of machine learning methods, including K-Nearest Neighbour (KNN), Support Vector Machine (SVM), Decision Tree (DT), and Regression approach, were compared to the suggested approach. Table 1 below provides a summary of the findings along with the accuracy ratings for each model.



Graph 1 - Accuracy Obtained by Various Models

MODELS	DATASET	ACCURACY	DR CLASSES
KNN	Messidor , Diabeticret DB1	55.1%	Normal, Non-PDR, PDR.
SVM	Messidor , Diabeticret DB1	85.6%	Normal, Non-PDR, PDR.
DT	Messidor	85.1%	Normal, Mild, Moderate, Severe
REGRESSION	Diabetic Retinopathy Detection 2015 &APTOS 2019 from Kaggle	78%	No DR, Mild, Moderate, Severe and Proliferative DR.
PROPOSED MODEL (DL MODEL)	APTOS 2019 from Kaggle	98%	No DR, Mild, Moderate, Severe and Proliferative DR.

Table 1 - Results Obtained by Various Models

INNOVATION IN OUR PROJECT

Based on the survey conducted, numerous methods have been devised to predict different stages of diabetic retinopathy. However, this project proposes a unique approach that utilizes Deep Learning Algorithms to detect the various stages of diabetic retinopathy at an early phase. The system not only provides automatic diagnosis but also facilitates web-based interaction with specialists. In addition, the feedback and description provided by the doctors are transmitted to the patients via SMS alerts on their mobile devices. This integrated approach aims to enhance the efficiency of diabetic retinopathy diagnosis, enable timely interventions, and ensure effective communication between healthcare providers and patients, ultimately improving the overall management of the condition.

SCOPE FOR FUTURE WORK

The completion of the modality marks a significant achievement, but its true value lies in its real-time application. To ensure its practicality, establishing a connection between the model and specialized doctors and technicians in rural areas is crucial. This integration would bring immense benefits to rural residents, representing a small yet impactful stride towards enhancing their well-being. By providing access to advanced healthcare technologies and expertise, the model's connection with rural healthcare professionals would bridge the gap in healthcare services, empowering them to make informed decisions and significantly improving the quality of care delivered to rural communities.

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