

# **DEEP LEARNING FUNDUS IMAGE ANALYSIS FOR EARLY DETECTION OF DIABETIC RETINOPATHY**

**A PROJECT REPORT**

**Submitted For the Partial Fulfillment of the Requirement for the Degree of  
Master of Science in Information Technology (M.Sc.-IT)**

**By**

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**INSTITUTE OF DISTANCE EDUCATION**

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**DECEMBER - 2023**

## **BONAFIDE CERTIFICATE**

This is to certify that the entitled **DEEP LEARNING FUNDUS IMAGE ANALYSIS FOR EARLY DETECTION OF DIABETIC RETINOPATHY** submitted to the University of Madras, Chennai by **R. SARATH (Reg. No. C22101PIT6031)** for the Partial Fulfillment for the award of degree of Master of Computer Science in Information Technology (M.Sc.-IT) is a Bonafide record of work carried out by him under my guidance and supervision.

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Co-Ordinator

**Dr. S. Sasikala, MCA, M.Phil., Ph.D.**

**Date:**

Submitted for the Viva - Voce Examination held on **17-12-2023** at IDE, University of Madras.

**Examiners:**

1. Name :

Signature :

2. Name :

Signature :



**Date: 25-11-2023**

### **COMPLETION CERTIFICATE**

This is to certify that **R. SARATH (Reg. No: C22101PIT6031)** undergoing his **MASTER OF SCIENCE in INFORMATION TECHNOLOGY** from **UNIVERSITY OF MADRAS (IDE)**, have completed his internship at this **BHARATH FIH TECHNOLOGIES** for a period of **6 MONTHS** from **JULY 2023 to DECEMBER 2023**. He has successfully completed the internship as **“DEEP LEARNING FUNDUS IMAGE ANALYSIS FOR EARLY DETECTION OF DIABETIC RETINOPATHY”**. It is observed that he is sincere and prompt in discharging the duties assigned to him from time to time.

On behalf of our organization, we wish him all the best in all his future endeavors.

Thanks & Regards,



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## **DECLARATION**

I, **R. SARATH** declare that this report on “**DEEP LEARNING FUNDUS IMAGE ANALYSIS FOR EARLY DETECTION OF DIABETIC RETINOPATHY**” is a bonafide report of the project work done by me in partial fulfillment for the award of the Degree **Master of Science in Information Technology (M.Sc.-IT)** by the University of Madras and further that this report is not a part of any other report that formed the basis for the award of any degree in any discipline in any university.

**Place:** Chennai

**R. SARATH**

**Date:** 17-12-2023

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# DEEP LEARNING FUNDUS IMAGE ANALYSIS FOR EARLY DETECTION OF DIABETIC RETINOPATHY

## ABSTRACT

Diabetic Retinopathy (DR) is a common complication of diabetes mellitus, which causes lesions on the retina that affect vision. If it is not detected early, it can lead to blindness. Unfortunately, DR is not a reversible process, and treatment only sustains vision. DR early detection and treatment can significantly reduce the risk of vision loss. The manual diagnosis process of DR retina fundus images by ophthalmologists is time, effort and cost-consuming and prone to misdiagnosis unlike computer-aided diagnosis systems.

Retinal screening contributes to early detection of diabetic retinopathy and timely treatment. To facilitate the screening process, we develop a deep learning system, named DeepDR, that can detect early-to-late stages of diabetic retinopathy. DeepDR is trained for real-time image quality assessment, lesion detection and grading using 466,247 fundus images from 121,342 patients with diabetes. Evaluation is performed on a local dataset with 200,136 fundus images from 52,004 patients and three external datasets with a total of 209,322 images. The area under the receiver operating characteristic curves for detecting microaneurysms, cotton-wool spots, hard exudates and haemorrhages are 0.901, 0.941, 0.954 and 0.967, respectively. The grading of diabetic retinopathy as mild, moderate, severe, and proliferative achieves area under the curves of 0.943, 0.955, 0.960 and 0.972, respectively. In external validations, the area under the curves for grading range from 0.916 to 0.970, which further supports the system is efficient for diabetic retinopathy grading.

**KEYWORDS:** Artificial intelligence, IDx-DR, fundus image, screening, Diabetic retinopathy, classification, severity staging system, pathophysiology.

# **1. INTRODUCTION**

## **1.1. ORGANIZATION PROFILE**

Bharat FIH Customer is the first IT Company that provides integrated customer lifecycle management services through a "multi-shore global delivery model". Multicore global delivery model enables Bharat FIH Customer to achieve operational excellence and consistently deliver the ‘promise of out-performance’ that is the differentiator of the company.

Bharat FIH has carved a niche in cutting-edge Web Technologies and has evolved a full-fledged offshore process model that leverages various engagement models.

Bharat FIH Customer’s promise of our performance is backed by our “Science behind Out performance”, which comprises a set of complex mathematical and analytical models. The process involves identifying performance outputs, drawing up detailed value stream process maps, discovering relationships between outputs and drivers using high level analytics and converting them into mathematical formulae. The result is a scientific approach to operations that drives out performance of our competition in an average of 70% of our current global engagements.

Bharat FIH range of expertise includes:

- Software Development Services
- Engineering Services
- Systems Integration
- Customer Relationship Management
- Supply Chain Management
- Product Development
- Electronic Commerce

## **1.2. PROJECT OVERVIEW**

The retina of the human eye can develop visible microvascular consequences from diabetes, including diabetic retinopathy and macular edema, the images of which are being employed for manual disease screening and diagnosis. Deep learning-based automatic detection for this labor-intensive task could be quite helpful. Although we only employ a tiny portion of