CHAPTER 1. INTRODUCTION

1.1 Background of the Project

Diabetes mellitus, often called diabetes, is one of the metabolic disorders that cause damage to the performance of organs, with the highest mortality rate in the world (Purnamasari et al., 2021). Diabetes occurs due to abnormalities in insulin secretion, or the pancreas cannot produce insulin properly. In contrast, insulin is a hormone that regulates blood sugar balance, increasing blood glucose (Anugrah et al., 2022). The number of diabetic patients is increasing worldwide, and the causes are population growth, aging, obesity, and lack of exercise. According to the International Diabetes Federation (2019), the number of people with diabetes in Indonesia is projected to increase from 10.7 million in 2019 to 13.7 million in 2030 (Milita et al., 2021). Diabetes mellitus can cause many complications in body parts and internal organs, including chest pain, paresthesias, nephropathy, neuropathy, and decreased vision, such as diabetic retinopathy (Fasil et al., 2019).

Diabetic retinopathy is a compilation of diabetes mellitus characterized by damage and blockage of the retinal blood vessels. Early symptoms of diabetic retinopathy are the formation of microaneurysms and leaks in blood vessels, venous abnormalities, retina swelling, abnormal growth of new blood vessels, and damage to nerve tissue (Abdullah et al., 2022). There are two main stages of diabetic retinopathy: Non-Proliferative Diabetic Retinopathy (NPDR) and Proliferative Diabetic Retinopathy (PDR). The NDPR stage is divided into three stages: mild, moderate, and severe (Qummar et al., 2019). Diabetic retinopathy at all stages can cause decreased vision within six months, accompanied by the appearance of black shadows in the vision. It can even cause blindness if not treated quickly (Yusran, 2017).

Early and accurate diagnosis of diabetic retinopathy is very important to minimize blindness and improve medical care. Ophthalmologists recommend that diabetic patients be screened at least twice a year to immediately diagnose signs of diabetic retinopathy (Pak et al., 2020). Currently, the treatment of diabetic retinopathy is carried out through several examinations, including biomicroscopy,

fluorescent angiography, ultrasonography, and Optical Coherence Tomography (OCT) (Invernizzi et al., 2020; Stathopoulos et al., 2018; Vergmann et al., 2020). The diagnosis is carried out through direct observation using a fundus camera and requires expert human interpretation, so the treatment process for patients becomes slower and inefficient (Tymchenko et al., 2020). A quick and precise examination aims to carry out stages of retinal therapy in patients through photocoagulation laser therapy and vitrectomy (Lin et al., 2018). Computer Vision is the right solution to analyze retinal images in diabetic retinopathy patients quickly.

Computer Vision in the modern era is widely applied in various fields such as agriculture, industry, and especially in the health sector. Computer Vision is a computer algorithm development system to simulate human visualization to extract information from an object (Liu & Liu, 2021). Computer Vision is a branch of artificial intelligence techniques related to human visualization. Visually the human eye and Computer Vision are the same. The goal is to interpret spatial data, namely data indexed by more than one dimension. In this study, researchers applied the Convolutional Neural Network as a classification method to build a detection model.

Based on the description above, the purpose of early detection of diabetic retinopathy is to build a website-based system that can classify and detect diabetic retinopathy severity level from an image of the eye's retina. So that the system can be implemented to help doctors and optometrists to make decisions and reduce the level of subjectivity in the process of diabetic retinopathy diagnosis. In addition, it is expected to make it easier to detect early to get the proper treatment quickly and efficiently for time.

1.2 Problem Statement

Based on the description that has been presented in the background above, the problems in this project are:

1. Diabetic retinopathy diagnosis is slow and not efficient

   Medical diagnosis to detect diabetic retinopathy takes a relatively long time. It is not efficient because it is done manually by an ophthalmologist by

observing the fundus image of the patient's retina (Mishra et al., 2020; Nguyen et al., 2020).

2. Detection of the stage level of diabetic retinopathy is difficult

Diabetic retinopathy is still difficult to recognize in every stages because it has to go through several processes, such as assessing the orange color of the retina, observing the edges and color of the optic disc (Rizky Yani & Sulistyaningrum, 2017).

3. The diabetic retinopathy detection system is not easily accessible via a computer or smartphone

The diabetic retinopathy detection systems that are widely developed are not easily accessible because their development has not reached the deployment stage to production (Subarkah, 2020).

1.3 Objectives

Objectives are the results to be achieved from this project. Here are the goals of this project:

1. To shorten the time that needed for an ophthalmologist or optometrist to make a diagnosis
2. To support the doctor's decision to determine the stage of diabetic retinopathy patients
3. To develop a website-based system by using artificial intelligence for the diabetic retinopathy detection

1.4 Scopes of the Project

1.4.1 User scope

a. Users can upload retinal images into the system.
b. Users can see the results of retinal images.
c. Users can see the results stages of diabetic retinopathy detection.

1.4.2 System scope

a. The system can classify normal images and *Diabetic Retinopathy* images in four severity level.
b. The system can send the results of the detection to the user after the classification process is complete.

1.5 Significance of the Project

Throughout this century, the existing diabetic retinopathy detector system seems to evolve continuously as the medical and information system field still provides opportunities throughout this competitive market. The advantages of this system are:

1. The interfaces are built to be suitable for the user, making them easier to use and more accessible.
2. By using preprocessing images, diabetic retinopathy detection becomes more effortless.
3. Help the ophthalmologist and optometrist in doing tasks specifically in detecting diabetic retinopathy.

Therefore, this project is relevant to the current market to enhance efficiency, productivity, and hassle-free experience.

1.6 Assumption and Limitation

1.6.1 Project assumption

a. The system can help ophthalmologists and optometrists to make decisions and quickly detect *Diabetic Retinopathy* stages.
b. The system can provide retinal images that have gone through preprocessing.

1.6.2 Project limitation

a. The system only focuses on the retina of the eye indicated by *Diabetic Retinopathy* in four severity level and the retina of the eye which is classified as normal.

b. The results of the detection system cannot be used as the main reference for diagnosing, it may have a detecting error.