



Image-Based Risk Assessment Analysis for Glaucoma Determination

Miad Faezipour and Mohammad Aloudat

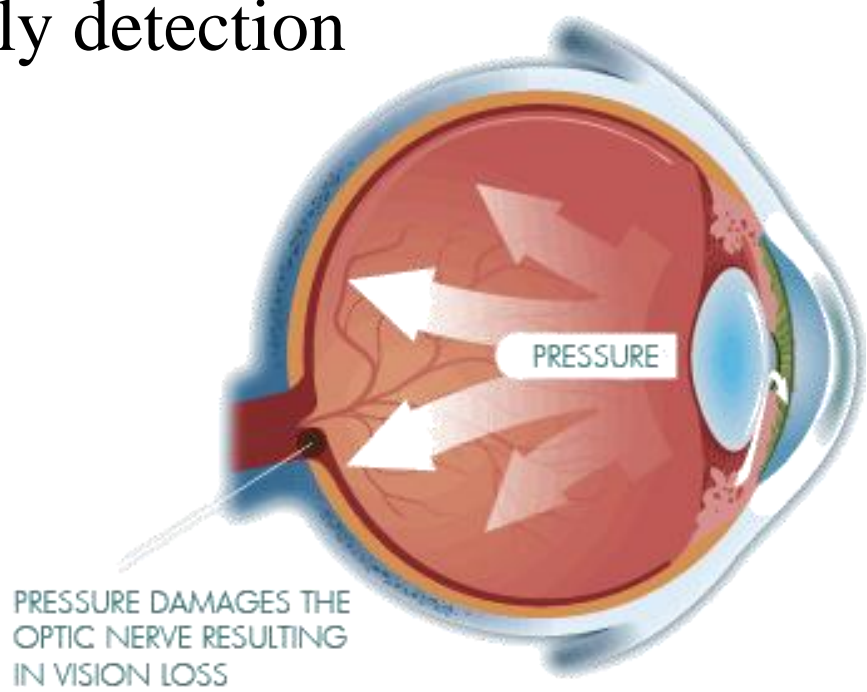
Department of Computer Science & Engineering and Biomedical Engineering
University of Bridgeport, CT 06604, USA

Abstract

Glaucoma is the most common cause of blindness in the world, and it is known as the silent thief of vision because it can sneak up on any patient. However, the loss of vision from Glaucoma is preventable. Glaucoma is caused by the gradual increase of pressure in the eye which is known as Intraocular Pressure (IOP). While the pressure increases in the eye, different parts of the eye become affected until the eye parts are damaged. The eye vessels' sizes are so small that they easily become affected. Moreover, the pressure inside the eye pushes the lens affecting the size of the Pupil. Also, the pressure in the eye presses the optic nerve in the back of the eye causing damage to the nerve fibers. Over 90% of Glaucoma cases have no signs or symptoms because peripheral vision can be lost before a person's central vision is affected. The only way to prevent Glaucoma is by early detection. This research study calculates three features from the frontal eye image that can be used to assess the risk of Glaucoma. These features include redness of the sclera, red area percentage, and the Pupil size. The database used in this work contains 100 facial images that have been divided into 50 healthy cases and 50 non-healthy cases with high eye pressure. Once the features were extracted, a neural network classification is applied to obtain the status of the patients in terms of eye pressure.

Glaucoma

- Glaucoma is a disease causing blindness, generally due to **increased intraocular pressure IOP**
- Optic nerve is affected
 - Vision is reduced, or totally lost
- The only way to prevent blindness from Glaucoma is through early detection

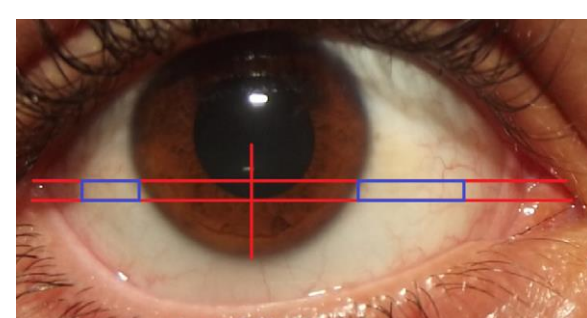


- Traditionally, patients undergo eye examinations on a regular basis at eye clinics to determine IOP and risk of Glaucoma
 - OCT, Visual Field, and Eye Pressure Test
 - Ophthalmologist's intervention
 - Fundus images
 - Requires micrometer imaging
 - Vessels
 - Eye drops
 - Cumbersome, manual procedure



Proposed Methodology

- A Glaucoma risk assessment framework introduced based on three features: the Pupil/Iris diameter ratio, the Mean Redness Level (MRL) and Red Area Percentage (RAP) of the sclera
- Image processing on frontal eye images
 - Ordinary camera
- Neural Network Classification
- Automatic
- Non-contact, Non-invasive



Database

- Image database (DB) from the Princess Basma Hospital used
- 100 participants
 - 50 with high eye pressure including 6 cases with Glaucoma
 - 50 healthy subjects
- 40 - 65 years old age range
- Each patient's level of eye pressure was recorded in the database
- Images were taken 20cm from the patients
- Images saved in JPEG format

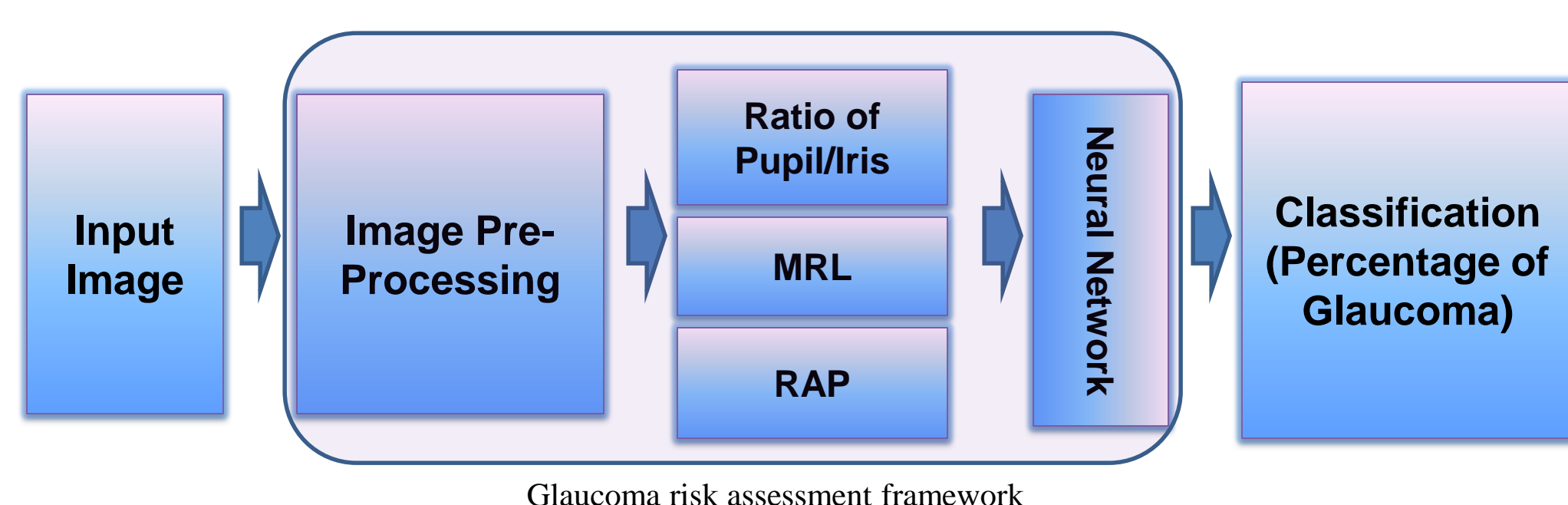
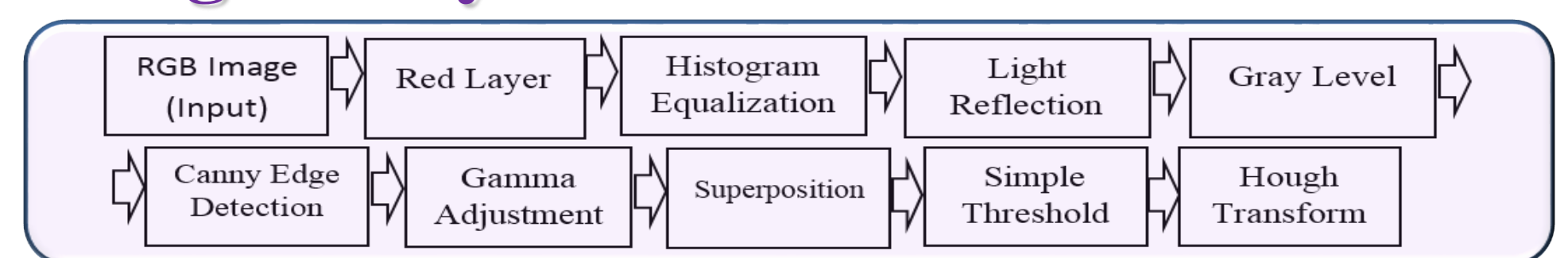
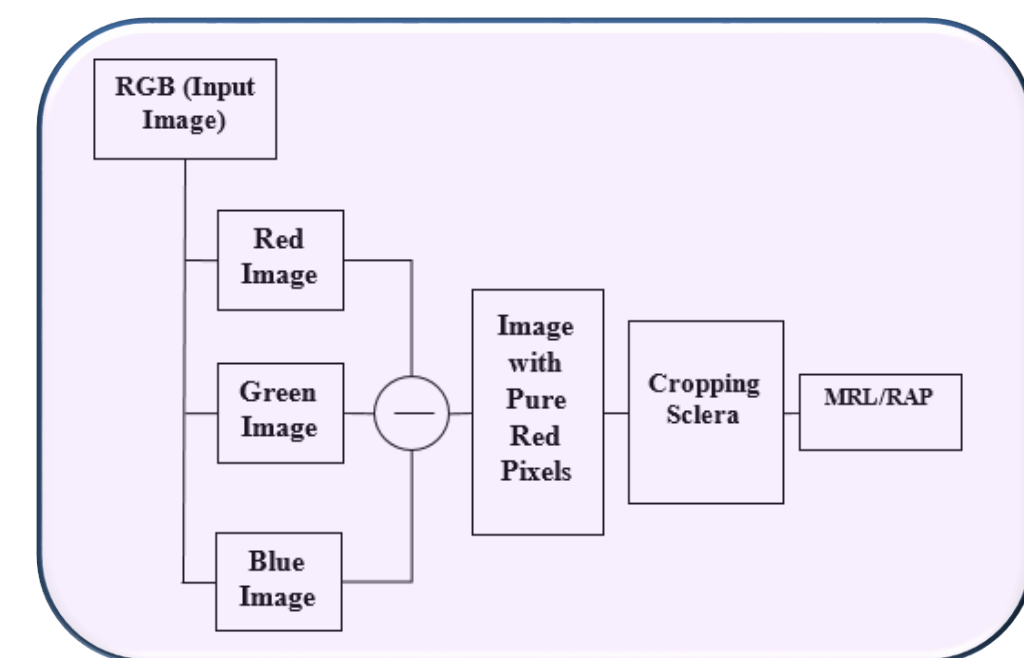


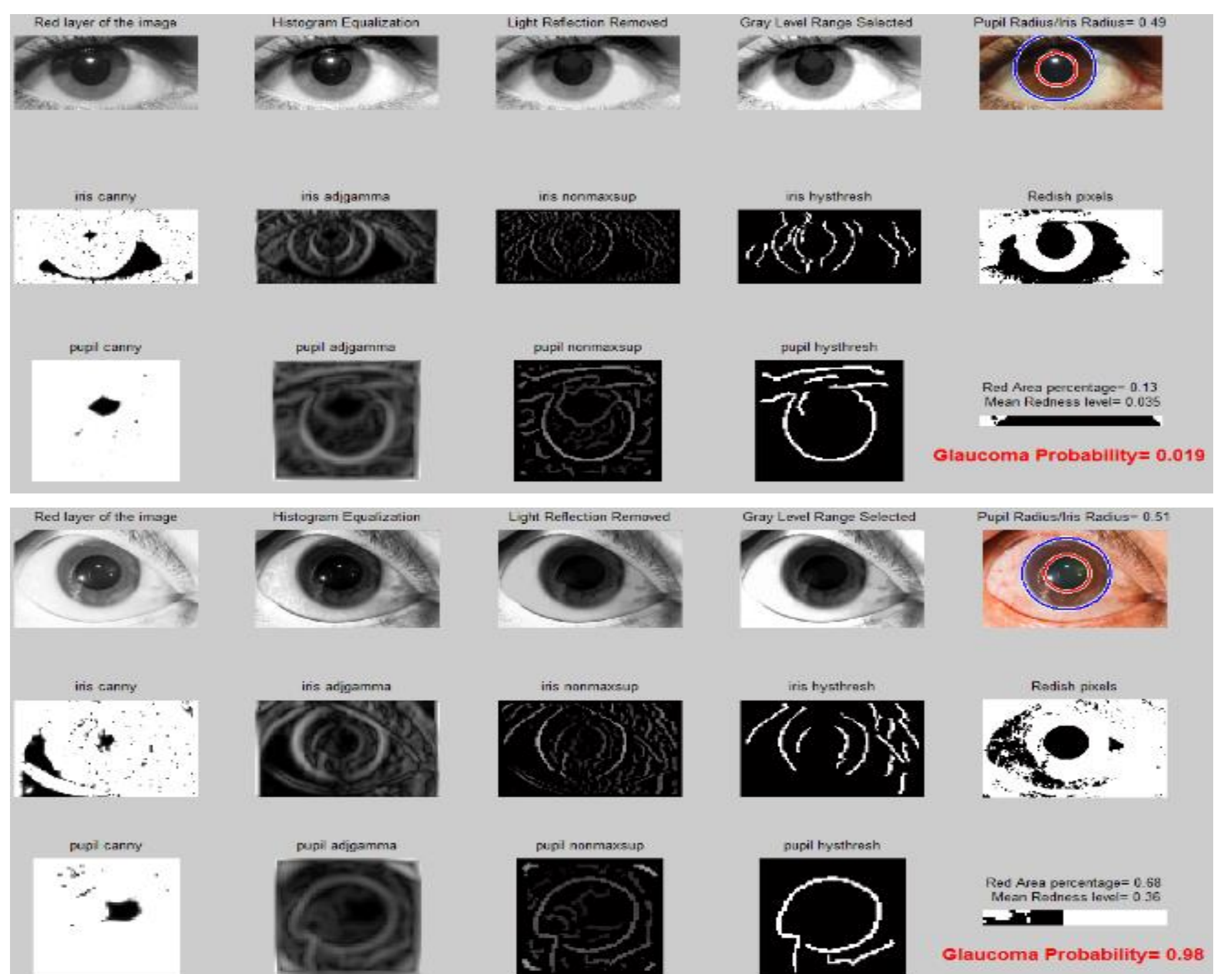
Image Analysis



Pupil/Iris diameter ratio computation steps



MRL and RAP computation steps



Results and Outcome

TABLE I. AVERAGE OF COMPUTED RESULTS FOR HEALTHY AND UNHEALTHY CASES BASED ON MRL/RAP AND PUPIL/IRIS DIAMETER RATIO VALUES.

Normal			High pressure			Glaucoma		
MRL	RAP	Pupil/Iris	MRL	RAP	Pupil/Iris	MRL	RAP	Pupil/Iris
0.12	0.24	0.55	0.51	0.89	0.64	0.62	0.97	0.72

Our system's framework produced evidence of the relationship between the three features extracted and Glaucoma, which has not been previously investigated through automated image processing techniques. The results show that there is a big difference between normal cases and people with high pressure/Glaucoma. This information will also, aid in the early detection of Glaucoma in an effort to help in preventing the blindness.



D-BEST Lab
Digital / Biomedical Embedded Systems & Technology Lab