Automatic Diagnosis of Diabetic Retinopathy

Using Retinal Fundus Image

MSc Research work by

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The Project

-BTH, Optimum Biometric, in conjunction with Dr. Bergen Jack of Blekinge Hospital intends applying Techniques of Digital Image Processing in the Diagnosis of Diabetic Retinopathy (DR).

- Result of experiments shows that the system can be used to augment Ophthalmologist work in the hospital.

- With further improvement, the system will totally replaced Screener’s work in the Diagnosis of DR.
Content

- Introduction
- Methodology
- Result Obtained
- Graphical User Interface (GUI)
- Conclusion and Recommendation
What is Diabetes?

- Diabetes is a disorder of metabolism
- Ability to Metabolise body Sugar impaired
- Leads to build up of glucose in the blood
- Overflow into urine and passes out of the body
- Secondary effects include Blindness, Stroke etc.
- More than 4% of Sweden population have Diabetes
What is Diabetic Retinopathy?

- The effect of diabetes on the eye is called Diabetic Retinopathy.
- It damages small blood vessels of the Retina.
- Might lead to loss of vision.
- Early detection and treatment is recommended.
- Treatment is by Laser Surgery.
Types of Diabetic Retinopathy (DR)

- **Type 1**: Background Diabetic Retinopathy; the arteries in the retina become weakened and leak, forming small, dot-like haemorrhages.

- **Type 2**: Proliferate Diabetic Retinopathy; circulation problems cause areas of the retina to become oxygen-deprived or ischemic. New fragile, vessels develop as the circulatory system attempts to maintain adequate oxygen levels within the retina.

- **Type 3**: Severe Diabetic Retinopathy; is continued abnormal vessel growth and scar tissue, which may cause serious problems such as retinal detachment and glaucoma and gradual loss of vision.
Symptoms of DR

- Microaneurysms (Red Spots)
- Haemorrhages (Bleeding)
- Hard Exudates
- Soft Exudates
- Vein-Artery Crossovers
- Neovascularisation

All these artifacts are very small
Process of Diagnosing DR

- Involve capturing Retinal Image using specialised Cameras
- This Image is Observed and Screened by a Trained screener
- If Diseases are detected, patient is referred to Specialised Ophthalmologist
- Screening is tedious, time consuming and need specialised training
- Hence need to augment the process
Automating the Screener’s Work

The aim includes:

- Developing a system that will be able to identify patients with Red Spot, Bleeding and Vein-Artery Crossover points.

- Developing a MATLAB Based Graphic User Interface (GUI) for the display of such Diseases.

- Developing a MATLAB based GUI tool to be used by the Ophthalmologist in marking Fundus Images.
What does a Retina Image Look like?

Grey Level Image

RGB Image

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- Diabetes?
- D. Retinopathy
- Types of DR
- Symptoms
- Diagnosing DR
- Automating DR
- Retina Images

Methodology
- Pre-Processing
- OFI
- PFI
- Comparison
- Segmentation
- SFI
- Classifier
- DCS
- DCS Output

Result Obtained
- GUI

Conclusion
Our Methodology!

Methodology

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Image Pre-Processing Stage (IPS)

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  - GUI

- **Conclusion**
IPS CONTD: ORIGINAL FUNDUS IMAGE (OFI)

- OFI is a grey level image
- Intensity value from 0-255
- Badly illuminated
- Hardly visible regions
- Need to be enhanced and equally illuminated
IPS CONTD: PRE PROCESSED FUNDUS IMAGE (PFI)

- PFI is a grey level image
- Intensity value from 0-255
- Well illuminated
- Visible regions and features
- Method used is Windowed Adaptive Histogram Equalisation with Zero Filling

Methodology

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COMPARING OFI WITH PFI

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Image Segmentation Stage (ISS)

Pre-Processed Fundus Image

Class Segmentation using K-means Method

Segmented Image

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Well Segmented Fundus Image using K-Means Algorithm

Segmented Image is a Binary Image

SFI
Disease Classifier Stage (DCS)

Diseases of Interest are:

- Microaneurysms (Red Spot)
- Haemorrhages (Bleeding)
- Vein-Artery Crossover Points
Disease Classifier Stage (DCS)

Segmented Image

Microaneurysm Detection

Bleeding Detection

Crossover points Detection

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DCS CONTD: CLASSIFIER SECTION

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- CVision GUI
- Red Spots Highlighted in Red
- Bleeding highlighted in blue
- Crossovers Highlighted in Green
Is the patient Normal or Abnormal?

- Specificity = 61%
- Sensitivity = 98%

**Sensitivity** is the percentage of abnormal fundus images classified as abnormal.

**Specificity** can be defined as the percentage of normal fundus images classified as normal.
MATLAB BASED GUI- Other work Done

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- FIDA-GUI for Image Marking
- CVision GUI for DR Diagnosis
Conclusion

- The system can assist in the Diagnosis of Diabetic Retinopathy.

Recommendations

- Classifier section should be improved.
- More diseases diagnosis should be added to the system.
- Vein-Artery Crossover point detection need improvement.
- More Research resources should be provided for this work.
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