MIDDLE EAST TECHNICAL UNIVERSITY
NORTHERN CYPRUS CAMPUS

# CNG 483 – INTRODUCTION TO COMPUTER VISION

## Project 3 – IRISDeep

**Objectives:** The purpose of this assignment is to familiarize yourselves with convolutional neural networks (CNN) by solving an identity recognition task based on iris recognition.

**Description:** In this project you are required to implement an identity recognition system based on convolutional neural networks (CNN), and to evaluate it with the provided dataset. All evaluations should be reported in a 3-4 pages long paper prepared in the format of given template.

The text continues with detailed explanations of the methods and requirements.

## 1. Identity recognition based on iris biometric data

The main purpose of the identity recognition systems is to determine the identity of the person in a query image. The recognition is done by evaluating semantic contents of the query image.

In a typical practical iris recognition system complete processing chain encompassing initial image segmentation, normalisation, feature encoding and the matching steps used to required. However, performance of these systems can be degraded very easily with the failure of the segmentation stage.

In order to overcome this diffculty iris recognirion can be formulated as a learning problem to match an image representation with the identity of person in the eye image. Hence, in this assignment you are required to construct a CNN with rectified linear unit (ReLU) as nonlinearity function between layers and train it using the provided images.

While training the network you are required to use softmax (cross-entropy loss) function to minimize the difference between actual identity and the estimated one.

## 2. Database

The commercially available data Set 2 (DS2) of the BioSecure Multimodal Database (BMDB) is utilised for this project. Four eye images (two left and two right) were acquired in two different sessions with a resolution of 640*480 pixels from 200 subjects. Since the left and right eye of an individual is completly different. You will consider them as a different individuals. Hence, in this case, database will contain 400 subjects each with 4 eye images. Consider the following example for better understanding;

| | |
|---|---|
| u001_s01_iris_ds2-lg-0l_01.bmp<br>u001_s01_iris_ds2-lg-0l_02.bmp<br>u001_s02_iris_ds2-lg-0l_01.bmp<br>u001_s02_iris_ds2-lg-0l_02.bmp | Person 1 left eye samples. These will be consider as Person 1. |
| u001_s01_iris_ds2-lg-0r_01.bmp<br>u001_s01_iris_ds2-lg-0r_02.bmp<br>u001_s02_iris_ds2-lg-0r_01.bmp<br>u001_s02_iris_ds2-lg-0r_02.bmp | Person 1 right eye samples. These will be consider as Person 2. |
| u002_s01_iris_ds2-lg-0l_01.bmp<br>u002_s01_iris_ds2-lg-0l_02.bmp<br>u002_s02_iris_ds2-lg-0l_01.bmp<br>u002_s02_iris_ds2-lg-0l_02.bmp | Person 2 left eye samples. These will be consider as Person 3. |
| u002_s01_iris_ds2-lg-0r_01.bmp<br>u002_s01_iris_ds2-lg-0r_02.bmp<br>u002_s02_iris_ds2-lg-0r_01.bmp<br>u002_s02_iris_ds2-lg-0r_02.bmp | Person 2 right eye samples. These will be consider as Person 4. |
| …… | |

2 samples per person should be used for training set, 1 sample per person should be used for validation set and 1 sample per person should be used for testing set.

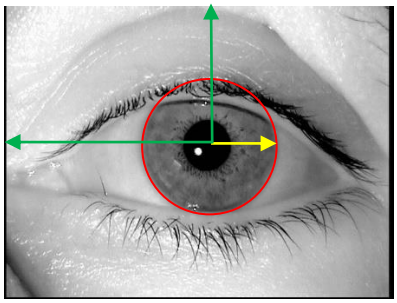
## 3. Iris Recognition

- **Pre-processing**
  First you should pre-process eye images. Simply, you should crop the eye images to only include the iris region by using the given information in parameters.txt. In this file, first info. is the name of the eye image, followed by the x and y coordinate (shown with green) and the radius (shown with yellow) of the iris in the image;

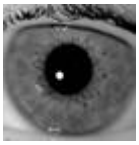
  **u001_s01_iris_ds2-lg-0l_01.bmp,231,338,110**

  Subsequently, all cropped images will be resized to a constant size of 128x128 and will be input the recognition.

Original Image



Cropped Image



- **Recognition**

For recognition you are expected to implement the provided architecture and find good hyperparameters like regularization, number of epochs, and learning rate to achieve good results.

The FIXED network architecture starts with convolution layer, followed by Relu, Pooling, and fully-connected (FC) layers and end with Softmax layer. For removing overfitting in the fully connected (FC) layers, dropout layers can be used at the end of each fully connected layer. It prevents all neurons from simultaneously updating weights.

Your model should consist of at least 2 convolution layers. Padding, stride, number of kernels, size of kernels for the convolution and pooling layers should be decided by you.

**Restrictions:**

- Stick with the given template for your report. It can be 3 to 4 pages. Design your report as you wish. However, points will be given for good presentation of work (i.e. explaining results using tables or graphs, explaining details of your CNN architecture with figures etc.)
- I will be running your codes for your best configuration found on the test set in order to reproduce your ranking results, so please do not forget to mention your setup explicitly.

## Grading:

- Pre-processing
- Recognition
- Performance of the system (higher performance higher points)
- Explanation (reasons) of used techniques for every stage
- Answering questions during demo
- Report

**Deadline:**

21/06/2020 23:55

**Regulations:**

1) **Group Project:** This Project can be done in group of 2 or 3. You should form your group and fill the information regarding to your group at the provided link until 10/06/2021. Please note that after this date you will not be able to change your group or to assign yourself to any group. I will assign students to groups randomly.

   Link:
   https://docs.google.com/spreadsheets/d/1Zeix4msdeaTC7Q4STxX71bKNdOmf2oKoIKRAeCjMfSQ/edit?usp=sharing

2) **Programming Language and Implementation:** You can use any programming language for the implementation. You must use comments to explain what your code is doing step by step. You are expected to make sure your code runs successfully.

3) **Report:** Stick with the given template for your report.

4) **Submission:** All files (code and report) should be submitted as zip folder with your group name. For example; group1. You must write your group members name, surname and student ID as a comment at the beginning of your program. Only one submission should be done per group.

5) **Demo:** You must be able to explain every single statement in your code. Hence, do not use any statement if you dont know it. Give appropriate references for used materials, but copying codes from any material is strictly forbidden. You must saved necesaary steps so that you can load them and run your program to show me the output during the demo. You must choose the suitable date and time for your project demo. Dates for this will be announced later. Check your emails regularly. You must come to your project demo on time.

6) **Deadline:** 21/06/2021 @23:55
7) **Late Submission:** Late submission via email will not be accepted.
8) **Cheating:** Please read carefully cheating policy from the course syllabus.

**Please note that failing to do any of the above regulations may result as zero grade.**