University of Kent | School of Engineering and Digital Arts

EDA ENGINEERING ASSIGNMENT COVER SHEET

Title: Assignment 2

Module: EENG5610 Image Analysis & Applications

Work Setter: DR S Hoque

Assessment: This assignment contributes **10%** of the module.

Deadline: Submission deadline: **11:59am Thursday Week 34 (**i.e., **27th March Midday)**
Marked work return date: Friday Week 40
Submit: **Online at Moodle**

Learning Outcomes: This assignment contributes to the assessment of the EL561 learning outcomes:

8.1 have an understanding of three main integrated themes: (i) basic image processing (representation, transformation, extraction of key information from images); (ii) image analysis (automatic interpretation of images and pattern recognition methodology) and (iii) computational architectures for image analysis (especially neural network structures)

8.2 have familiarity with fundamental algorithms underpinning modern image analysis systems

8.3 have experience of the requirements for implementing algorithms for image analysis

8.4 have practical experience of working with typical algorithms and architectures

Feedback method: Feedback will be via:

- ✓ Model solution on Moodle;
- ✓ Written comments on work;
- ✓ Verbal comments in class;
- ✓ One to one discussion (*if requested*).

You are reminded of the University rules on Academic Integrity as stated in the student handbook. Examples of conduct regarded as a breach of these regulations include:

- *Plagiarism: reproducing in any work submitted for assessment or review (for example, examination answers, essays, project reports, dissertations or theses) any material derived from work authored by another, without clearly acknowledging the source*
- *Duplication of Material*
- *Conspiring with others to reproduce the work of others without proper acknowledgement, including knowingly permitting work to be copied by another student*
- *Falsification of data/evidence.*

Marking Criteria
This assignment will be marked against a model solution which will be made available. The marks awarded will be consistent with the scores indicated in the assignment sheet. In general, **marks may be lost for work which does not show the method adequately**, include the correct units, or is poorly structured and difficult to follow. If assumptions are required, you should state them and justify why they are appropriate. If the work asks you to comment on the final result you should make an appropriate conclusion.

EENG5610 – Assignment 2

Answer all questions.

1. Figure 1 illustrates a simple "test image". The numbers represent the Gray-scale intensities of the pixels.

   (a) Determine the Gray-level co-occurrence matrix (GLCM) where the pixel offset is defined by $d = 1$ and $\theta = 90°$ (also described as [0, 1]). Hence, estimate the texture features (i) entropy, (ii) contrast, (iii) energy for the image in Figure1.

   [5 marks]

   (b) What would be the texture energy if the offset is changed to $d = 1$ and $\theta = 45°$.

   [3 marks]

0	0	1	1	1
0	0	1	1	2
0	2	2	2	3
2	2	3	3	3
2	2	2	3	3

Figure 1

2. You are evaluating a biometric system for potential use in a security application. Experimental measurements of False Rejection Rate (FRR) and False Acceptance Rate (FAR) values have been estimated at different threshold settings and are presented in Figure 2.

   (a) Determine the Equal Error Rate (EER) of the system from the plots. [You need to annotate the plot showing how you derived the value.]

   [3 marks]

   (b) The security application needs an FAR not greater than 15% and an FRR less than 25%. Would you recommend procuring this system for the application? Explain briefly. [You need to carry out this analysis using Figure 2. You need to explain/annotate how your decision is reached.]

   [4 marks]

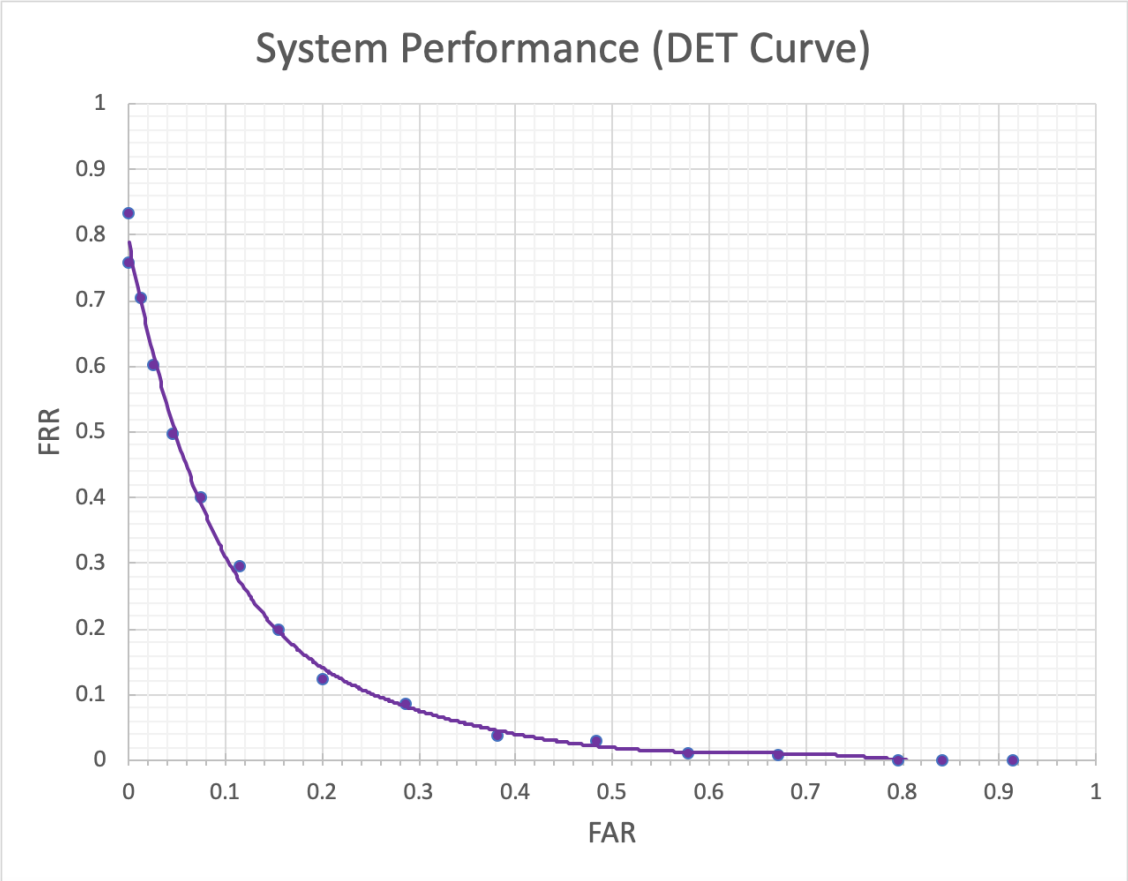

Figure 2

3. An automated handwritten signature verification system is being tested. Twenty five volunteers ('01' to '25') are enrolled for this exercise. They attempt to access the system both as genuine users as well as impostors (i.e., pretending to be someone else). Table 1 shows the data log of the matching **score**s from these trial attempts (denoting the <u>similarity</u> of the presented biometric to the enrolled template). The scores ranged between [0 1]. A high score implies better match between the live sample and the stored template. Any match score <u>greater than</u> the operator-selected threshold (θ) results in successful authentication.

(a) Calculate the False Acceptance Rate (FAR) and the False Rejection Rate (FRR) of the system for a threshold of θ = 0.65.

[4 marks]

(b) Also determine the FAR and FRR values for θ = 0.25, 0.35, 0.45, 0.55 and 0.75.

[2 marks]

(c) Hence plot the Detector-Error-Trade-off (DET) characteristics of the system. [You <u>must use a proper graph paper</u> for this plot. The plot may be hand drawn or software generated. A hand-drawn graph on a plain paper will not be adequate.]

[3 marks]

(d) Determine, graphically or otherwise, the Equal Error Rate (EER) of the system.

[1 marks]

Table 1

true ID	claimed ID	score	true ID	claimed ID	score	true ID	claimed ID	score
01	01	0.98	08	13	0.01	17	08	0.68
01	01	0.73	08	14	0.41	17	11	0.22
01	11	0.32	10	05	0.25	17	17	0.80
01	17	0.21	10	07	0.14	17	17	0.88
01	20	0.36	10	10	0.64	17	17	0.97
01	22	0.23	10	10	0.70	17	17	0.69
02	02	0.43	10	10	0.63	17	21	0.38
02	06	0.23	10	19	0.47	18	15	0.44
02	13	0.39	11	09	0.40	18	18	0.56
02	23	0.27	11	11	0.78	18	18	0.47
03	03	0.79	11	11	0.95	19	01	0.34
03	03	0.41	11	11	0.60	19	07	0.08
03	18	0.16	11	14	0.36	19	12	0.20
03	22	0.58	12	01	0.39	20	20	0.89
04	04	0.69	12	12	0.81	20	20	0.77
04	04	0.61	12	12	0.65	20	20	0.76
04	04	0.70	12	12	0.95	21	13	0.15
04	04	0.48	12	12	0.74	21	14	0.43
04	04	0.64	12	12	0.48	21	19	0.34
04	11	0.55	12	20	0.56	21	21	0.79
04	13	0.67	12	20	0.60	21	21	0.72
04	13	0.90	13	05	0.11	21	25	0.13
04	14	0.47	13	13	0.72	22	01	0.51
05	05	0.92	13	13	0.74	22	03	0.72
05	05	0.68	13	13	0.81	22	12	0.04
05	05	0.42	13	13	0.63	22	22	0.78
05	05	0.61	13	13	0.56	23	06	0.26
05	07	0.25	13	13	0.91	23	08	0.27
05	24	0.33	14	04	0.11	23	13	0.70
06	06	0.71	14	14	0.70	23	23	0.92
06	06	0.78	14	14	0.59	23	23	0.65
06	06	0.89	14	14	0.29	23	23	0.40
06	06	0.88	14	14	0.51	23	23	0.18
06	20	0.17	15	03	0.24	23	23	0.66
06	24	0.61	15	10	0.32	24	02	0.55
07	07	0.64	15	15	0.64	24	23	0.68
07	07	0.67	15	15	0.52	24	24	0.51
07	07	0.56	15	15	0.73	25	03	0.68
07	07	0.81	15	18	0.52	25	21	0.21
07	07	0.96	15	21	0.32	25	24	0.16
07	14	0.29	15	25	0.46	25	25	0.69
07	18	0.49	16	11	0.42	25	25	0.77
08	04	0.57	16	16	0.71	25	25	0.72
08	04	0.06	16	16	0.95	25	25	0.97
08	08	0.77	16	19	0.23	25	25	0.71