Design and Evaluate an Iris Recognition System

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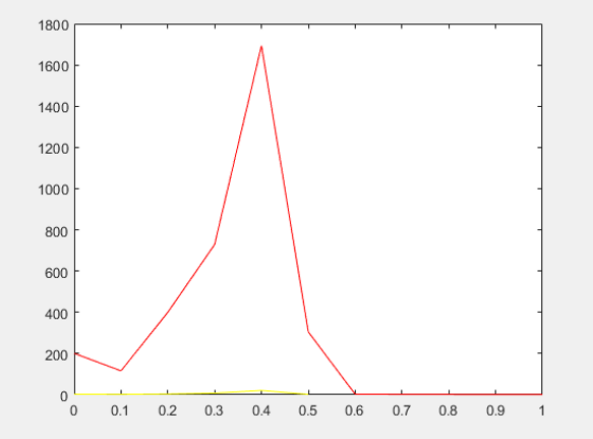
1. Description of our Iris recognition system

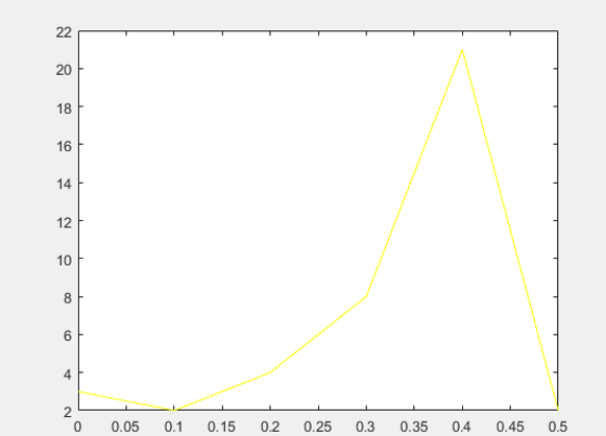
We used LG2200 2008 data to build the gallery of our system. Using Libor Masek's open source iris matching code, we obtained templates and masks of those Iris images. With the .txt file in each folder, we were able to save right Iris templates and left templates into two separate folders. To save time, we only calculated two right Iris images and two left Iris images for each folder (each person). After the gallery established, we used probes data to match gallery templates. First, we used LG 4000 data as probes. For each folder in LG 4000, we chose two left Iris images to calculate their templates and masks, then we used these templates and masks to compare with all the templates and masks in the folder we saved left Iris gallery. We get two data for each comparison, one is the hamming distance and the other is a data to indicate whether the two templates that compared are the same person. Also, we chose two right Iris images to calculate their templates and masks and compared with all the templates and masks in the folder we saved right Iris gallery. Then, we used LG2200 2010 data as probes. The match process was almost the same as above. Finally, we used the data we got to draw the genuine and impostor distribution plots, ROC curves and CMC curves to evaluate our Iris recognition system.

2. LG 4000

(1) Genuine and Impostor Distribution Plots

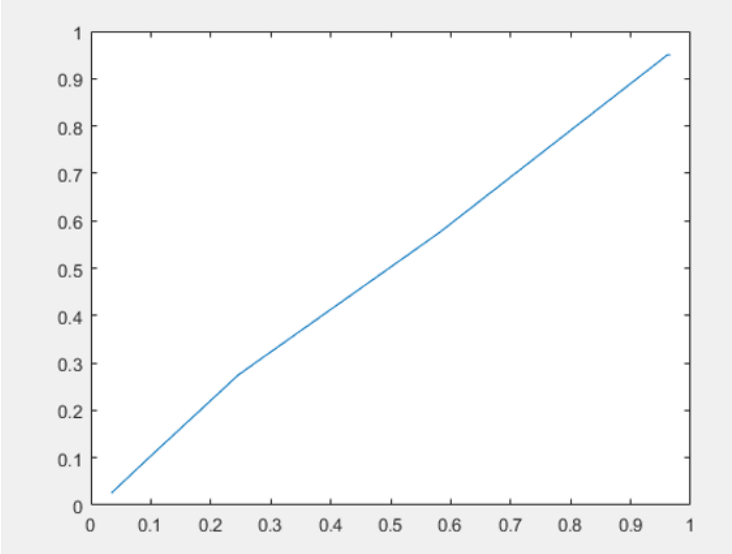


(Genuine and Impostor Distribution Plots)



(Genuine Plots)

(2) ROC Curve

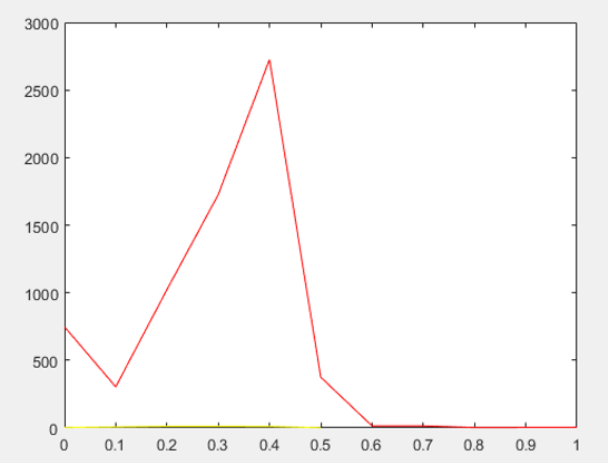


(3) Findings

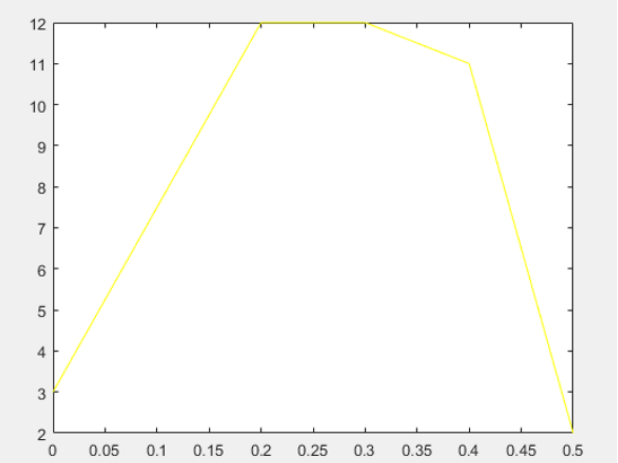
The ROC is not that perfect. We think it is because the number of matched between the Iris images of the same person is much less than the number of matched between different people. However, we can at least see that the peak of genuine curve is on the left of the peak of imposter curve in genuine and impostor distribution plots. Also, we can see that our Iris recognition system is not very accurate from the ROC curve.

3. LG 2200 2010

(1) Genuine and Impostor Distribution Plots

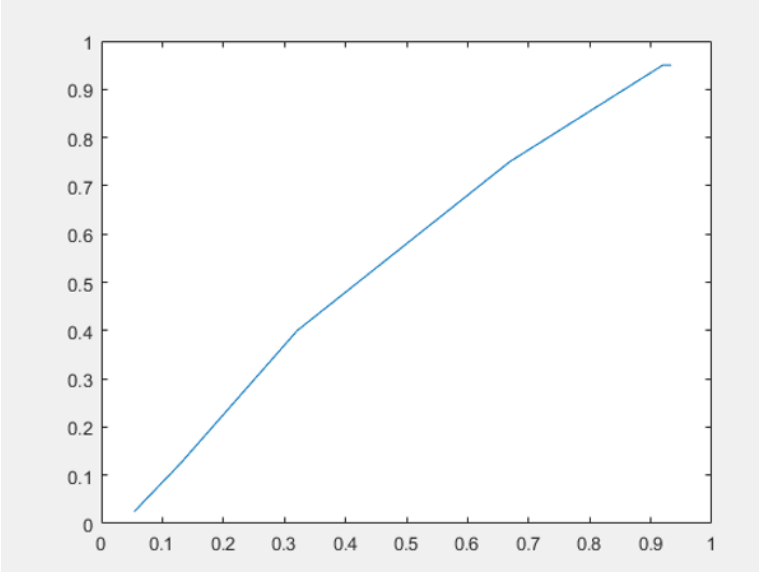


(Genuine and Impostor Distribution Plots)



(Genuine Plots)

(2) ROC Curve



(3) Findings

The same as LG 4000 probes. The ROC is not that perfect but we can at least see that the peak of genuine curve is on the left of the peak of imposter curve in genuine and impostor distribution plots. Also, we can see that our Iris recognition system is not very accurate from the ROC curve.

4. Source Code

(1) BuildGallery.m

```
%compute template and mask of gallery
GetFile = get_all_files('D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2008-03-11_13');

hd=[];
leftcount=0;
rightcount=0;
ii=1;
for i=1113:1242

  filename=cell2mat(GetFile(i));

  if filename(end-2:end) == 'txt'

    %Decide left eye or right eye
    Eye=[];
    j=1;
    ii=1;
    leftcount=0;
    rightcount=0;
```

```
    L='eye        string    Left';
    R='eye        string    Right';
    fid=fopen(filename,'r');
    while 1
      tline = fgetl(fid);
      if tline == -1
        break;
      end

      if strcmp(tline,L) %0 means left
        Eye(j)=0;
        j=j+1;
      end
      if strcmp(tline,R) %1 means right
        Eye(j)=1;
        j=j+1;
      end
    end
    fclose(fid);
  end
  if filename(end-3:end)=='tiff'
    if leftcount<2 || rightcount<2
      if Eye(ii)==0 && leftcount<2
        [template1, mask1] = createiristemplate(filename);
        a = strcat(filename(90:end-5),'Temp.mat');
        b = strcat(filename(90:end-5),'Mask.mat');
        save([strcat('D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2008-03-
11_13\left\'),a],'template1');
        save([strcat('D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2008-03-
11_13\left\'),b],'mask1');
        leftcount=leftcount+1;
      end
      if Eye(ii)==1 && rightcount<2
        [template1, mask1] = createiristemplate(filename);
        a = strcat(filename(90:end-5),'Temp.mat');
        b = strcat(filename(90:end-5),'Mask.mat');
        save([strcat('D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2008-03-
11_13\right\'),a],'template1');
        save([strcat('D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2008-03-
11_13\right\'),b],'mask1');
        rightcount=rightcount+1;
      end
      ii=ii+1;
    end
```

```
    end
  end
```

(2) ProbeCompareWithGallery.m

```
GetFileLeft = get_all_files('D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2008-03-11_13\left');
GetFileRight = get_all_files('D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2008-03-11_13\right');
GetFileProbe = get_all_files('D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2010-04-27_29');
hd_self=[];
hd_oth=[];
x=1;
y=1;
leftcount=0;
rightcount=0;
ii=1;
for i=281:530

  filenameP=cell2mat(GetFileProbe(i));

  if filenameP(end-2:end) == 'txt'

    %Decide left eye or right eye
    Eye=[]; %record the eyes in images are left eye or right eye
    j=1;
    ii=1;
    leftcount=0;
    rightcount=0;
    L='eye       string    Left';
    R='eye       string    Right';
    fid=fopen(filenameP,'r');
    while 1
      tline = fgetl(fid);
      if tline == -1
        break;
      end

      if strcmp(tline,L) %0 means left eye
        Eye(j)=0;
        j=j+1;
      end
      if strcmp(tline,R) %1 means right eye
```

```
            Eye(j)=1;
            j=j+1;
          end
        end
        fclose(fid);
    end
    if filenameP(end-3:end)=='tiff'
        if leftcount<2 || rightcount<2   %choose 2 left eye images and 2 right eye images of one
person as probe
          if Eye(ii)==0 && leftcount<2
            [template2, mask2] = createiristemplate(filenameP);
%               a = strcat(filenameP(end-14:end-5),'Temp.mat');
%               b = strcat(filenameP(end-14:end-5),'Mask.mat');
%               save([strcat(filenameP(1:end-15),'left\'),a],'template2');
%               save([strcat(filenameP(1:end-15),'left\'),b],'mask2');
            leftcount=leftcount+1;
             for n=1:2:length(GetFileLeft)-1
                filenameLM=cell2mat(GetFileLeft(n));
                filenameLT=cell2mat(GetFileLeft(n+1));
                load(filenameLM);    %load left eye's template in gallery (as template1)
                load(filenameLT);    %load left eye's mask in gallery (as mask1)
               if filenameP(84:88)==filenameLM(75:79)
                  hd_self(x) = gethammingdistance(template1, mask1, template2, mask2, 10);  %if
the eye images are from the same person (probe is true)
                  x=x+1;
               else
                  hd_oth(y) = gethammingdistance(template1, mask1, template2, mask2, 10);    %if
the eye images are not from the same person
                  y=y+1;
               end

             end
          end
          if Eye(ii)==1 && rightcount<2
            [template2, mask2] = createiristemplate(filenameP);
%               a = strcat(filenameP(end-14:end-5),'Temp.mat');
%               b = strcat(filenameP(end-14:end-5),'Mask.mat');
%               save([strcat(filenameP(1:end-15),'right\'),a],'template2');
%               save([strcat(filenameP(1:end-15),'right\'),b],'mask2');
            rightcount=rightcount+1;
             for n=1:2:length(GetFileRight)-1
                filenameRM=cell2mat(GetFileRight(n));
                filenameRT=cell2mat(GetFileRight(n+1));
                load(filenameRM);   %load right eye's template in gallery (as template1)
```

```
                load(filenameRT);    %load right eye's template in gallery (as mask1)
                if filenameP(84:88)==filenameRM(76:80)
                   hd_self(x) = gethammingdistance(template1, mask1, template2, mask2, 10);
                   x=x+1;
                else
                   hd_oth(y) = gethammingdistance(template1, mask1, template2, mask2, 10);
                   y=y+1;
                end

              end
            end
            ii=ii+1;
          end

        end
      end
      save(['D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2010-04-
      27_29\hd\','hd_self'],'hd_self');
      save(['D:\NU\2017 FALL\EECS 495 Biometrics\Assignment2\LG2200-2010-04-
      27_29\hd\','hd_others'],'hd_oth');
```

(3) DrawGenuineImposter.m

```
GetFileHD = get_all_files('E:\Courses\495Biometrics\HW2\iriscode\Test\hd\');

  HD_O =cell2mat(GetFileHD(1));
  HD_S =cell2mat(GetFileHD(2));
  load(HD_S);
  load(HD_O);

 a = hd_self;
 b=zeros(size(a));

 for i=1:length(a)
   if a(i) ~= 0 && a(i)<=0.15
      b(i) = 0.1;
   end
    if a(i) ~= 0 && a(i)<=0.25 && a(i)>0.15
      b(i) = 0.2;
    end
   if a(i) ~= 0 && a(i)<=0.35 && a(i)>0.25
      b(i) = 0.3;

   end
   if a(i) ~= 0 && a(i)<=0.45 && a(i)>0.35
      b(i) = 0.4;
```

```
 end
 if a(i) ~= 0 && a(i)<=0.55 && a(i)>0.45
    b(i) = 0.5;
 end
 if a(i) ~= 0 && a(i)<=0.65 && a(i)>0.55
    b(i) = 0.6;
 end
 if a(i) ~= 0 && a(i)<=0.75 && a(i)>0.65
    b(i) = 0.7;
 end
  if a(i) ~= 0 && a(i)<=0.85 && a(i)>0.75
    b(i) = 0.8;
  end
  if a(i) ~= 0 && a(i)<=0.95 && a(i)>0.85
    b(i) = 0.9;
  end
    if a(i) ~= 0 && a(i)<=1 && a(i)>0.95
    b(i) = 1;
    end
end
tb1 = tabulate(b)

c=zeros(size(hd_oth));
 for i=1:length(hd_oth)
  if hd_oth(i) ~= 0 && hd_oth(i)<=0.15
    c(i) = 0.1;
  end
   if hd_oth(i) ~= 0 && hd_oth(i)<=0.25 && hd_oth(i)>0.15
    c(i) = 0.2;
   end
  if hd_oth(i) ~= 0 && hd_oth(i)<=0.35 && hd_oth(i)>0.25
    c(i) = 0.3;

  end
  if hd_oth(i) ~= 0 && hd_oth(i)<=0.45 && hd_oth(i)>0.35
    c(i) = 0.4;
  end
 if hd_oth(i) ~= 0 && hd_oth(i)<=0.55 && hd_oth(i)>0.45
    c(i) = 0.5;
 end
 if hd_oth(i) ~= 0 && hd_oth(i)<=0.65 && hd_oth(i)>0.55
    c(i) = 0.6;
 end
 if hd_oth(i) ~= 0 && hd_oth(i)<=0.75 && hd_oth(i)>0.65
```

```
      c(i) = 0.7;
  end
   if hd_oth(i) ~= 0 && hd_oth(i)<=0.85 && hd_oth(i)>0.75
     c(i) = 0.8;
   end
   if hd_oth(i) ~= 0 && hd_oth(i)<=0.95 && hd_oth(i)>0.85
     c(i) = 0.9;
   end
    if hd_oth(i) ~= 0 && hd_oth(i)<=1 && hd_oth(i)>0.95
     c(i) = 1;
    end
end
tb2 = tabulate(c)
x1 = tb1(:,1);%hd_self
y1 = tb1(:,2);

x2 = tb2(:,1);%hd_others
y2 = tb2(:,2);

plot(x1,y1,'y',x2,y2,'r')
```