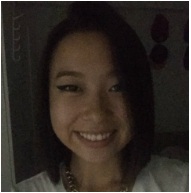
**CHAPTER 3**

**METHODOLOGHY**

**MANUAL SIMULATION**

**Problem 1:** Sensitivity to illumination cause inaccurate or inability to recognize a person.

*** Training Face Input Image***

***Figure 3.1:*** *Images with different illumination conditions. The Input Image has a darker lighting.*

**Objective 1:** Eigenface algorithm that can adapt to various lighting environment settings that will help the recognition to be more accurate and assure the identification of faces.

**Existing Algorithm Simulation**

* Get colored image and convert into greyscale image.
* Get image data in form of a ***N x N* matrix** represented as *I*.  
  *The N will be equal to 3 to produce a small scale N X N Matrix.*

*I* = 79 96 83  
 81 103 79   
 103 99 111

*(Lower value indicates darker greyscale pixel)*

* Convert *I* into ***N2x 1*** vector represented as ***Γ***.   
   ***Γ*** = 79  
   96  
   83  
   81  
   103  
   79  
   103  
   99  
   111

**Proposed Algorithm Simulation**

* Get colored image and convert into greyscale image.
* Get image data in form of a ***N x N* matrix** represented as *I*.  
  *N will be equal to 3 to produce a small scale sample of N x N matrix.*

*I* = 79 96 83  
 81 103 79   
 103 99 111

*(Lower value indicates darker greyscale pixel)*

* Convert *I* into ***N2x 1*** vector represented as ***Γ***.   
   ***Γ*** = 79  
   96  
   83  
   81  
   103  
   79  
   103  
   99  
   111

* Calculate image data mean of Training faces.

*Sample mean* ***Γ*** = 125  
 153  
 144  
 139  
 166  
 133  
 143  
 155  
 157

* Compare image data of input image and mean of training faces represented as Ψ.

***Γ*** = Ψ - 46  
 Ψ - 57  
 Ψ - 61  
 Ψ - 58  
 Ψ - 63  
 Ψ - 54  
 Ψ - 40  
 Ψ - 56  
 Ψ - 46

*(In this case, the input image seemed darker than the average face lighting)*

* Calculate difference mean and adjust image data according to the difference mean.  
    
  46 + 57 + 61 + 58 + 63 + 54 + 40 +56 + 46 = 481

481/9 = 53 (mean)

***Γ*** = 79 + 53  ***Γ*** = 132  
 96 + 53 149  
 83 + 53 136  
 81 + 53 134  
 103 + 53 156  
 79 + 53 132  
 103 + 53 156  
 99 + 53 152  
 111+ 53 164

*(In this case, the input image’s overall brightness was increased)*

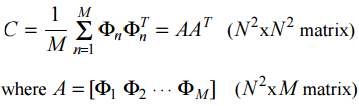
**Problem 2:** Eigenface Algorithm is susceptible to produces less accurate results compared to the input face image.

**Objective 2:** Eigenface algorithm that will generate a more reliable output and provide the best matches of the inputted image.

**Problem 3:** Inefficiency of PCA’s Dimension Reduction when total number of training faces (M) is larger to the squared of training face dimension (N*2*).  
**Objective 3:** Eigenface algorithm that will maintain and offer a simple yet flexible integration in face recognition systems and sustain a low-level processing that will keep its efficiency.

**Existing Algorithm Simulation**

The calculation of the covariance matrix ***C*** is as follows:



Except the matrix ***AAT* (*N2x N2*matrix)** is very large.

*For example:*

*Number of training face (****M)*** = 250   
*Pixel length of the grey scale image* ***N*** = 50

*The calculation for the covariance matrix* ***C*** *would have the result of:*

***C*** *= ((50)2 x (50)2 matrix)*

*C = (2500 x 2500 matrix) <== Too Large*

Following the PCA’s Dimension Reduction, the matrix ***ATA* (*M x M* matrix)** will be considered instead.

*AAT = ATA* (*M x M* matrix)

***C*** *= ((250 x (250) matrix)*

**Proposed Algorithm Simulation**

The calculation of the covariance matrix ***C*,** following PCA’s Dimension Reduction, is as follows:

*ATA* (*M x M* matrix)

Except the matrix ***AAT* (*N2 x N2*matrix)**is very large. Following the PCA’s Dimension Reduction, the matrix ***ATA* (*M x M* matrix)** will be considered instead.

However, when the value of ***M*** is comparable to, or even larger than ***N2***, the Dimension Reduction will not be effective.

*For example:*

*Number of training face (****M)*** = 4200   
*Pixel length of the grey scale image* ***N*** = 50

*The calculation for the covariance matrix* ***C*** *would have the result of:*

*C=(4200 x 4200 matrix)<== Too Large*

**In that case, if ***M*** is larger than ***N2***the computation for the covariance matrix ***C*** will be as follows:

*C = ((50)2 x (50)2 matrix)*

*C = (2500 x 2500 matrix)*