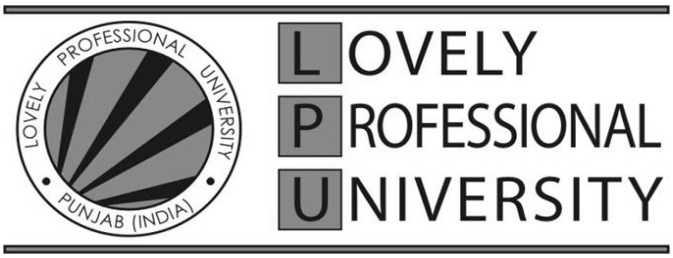


AN EFFICIENT TECHNIQUE FOR GAIT RECOGNITION USING WIDTH VECTOR, ANGLES AND MDA

A Dissertation Report Submitted

BY

Katakam Santosh

(11300609)

To

Department of Computer Science

In partial fulfilment of the Requirement for the

Award of the Degree of

Master of Technology in Computer Science & Engineering

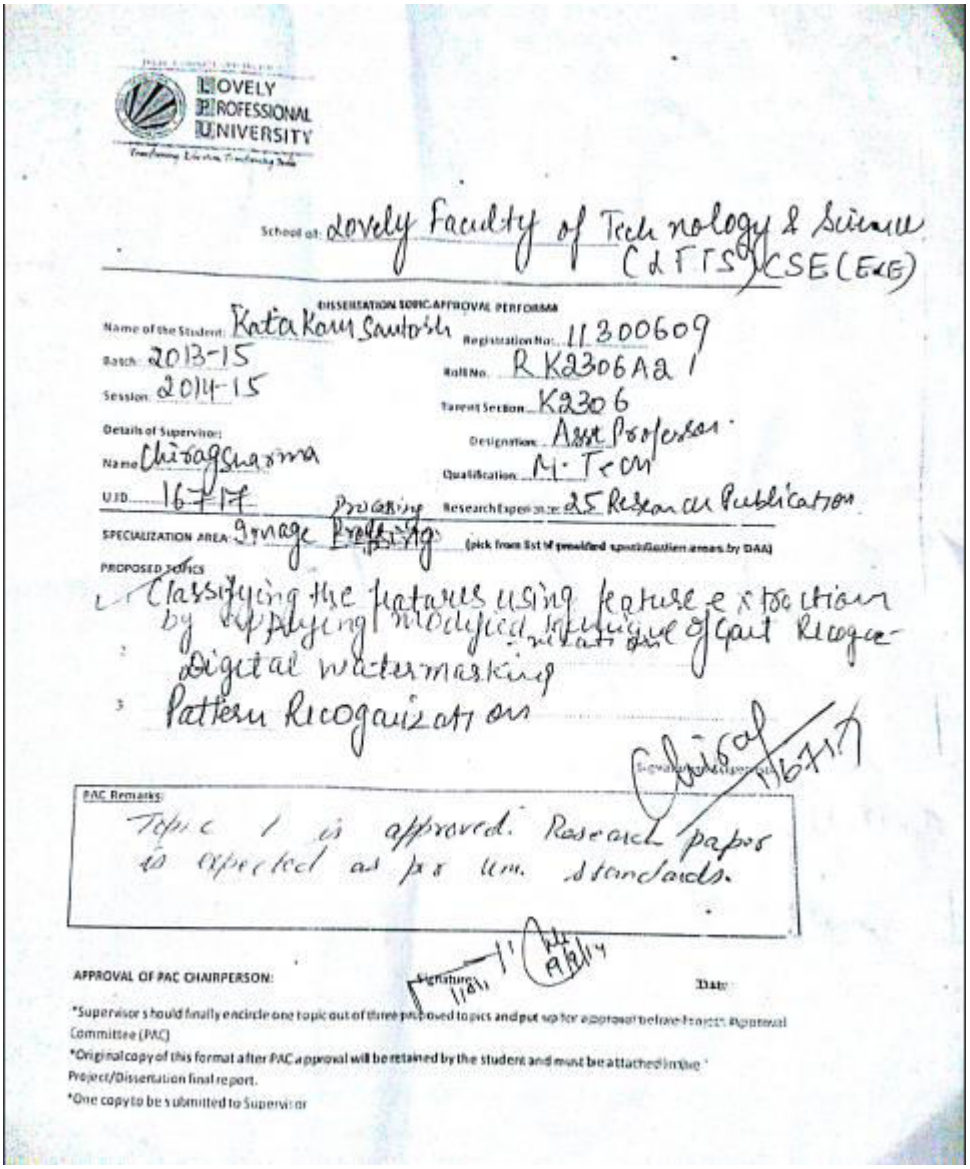
Under the guidance of

Mr. Chirag Sharma

Assistant Professor

(MAY, 2015)

PAC APPROVAL FORM



LOVELY PROFESSIONAL UNIVERSITY

School of: Lovely Faculty of Technology & Sciences (LFTS) CSE(EXE)

DISSERTATION TOPIC APPROVAL PERFORMA

Name of the Student: Kata Kam Santosh Registration No: 11300609

Batch: 2013-15 Roll No. RK2306A21

Session: 2014-15 Parent Section: K2306

Details of Supervisor:

Name: Chirag Sharma Designation: Asst Professor

U.I.D. 16717 Qualification: M. Tech

Research Experience: 25 Research Publication

SPECIALIZATION AREA: Image Processing (pick from list of specialization areas by DAA)

PROPOSED TOPICS

1. Classifying the features using feature extraction by applying modified technique of Gait Recognition
2. Digital watermarking
3. Pattern Recognization

Signature of Supervisor 16717

PAC Remarks:

Topic 1 is approved. Research paper to expected as per Um. standards.

APPROVAL OF PAC CHAIRPERSON: Signature 11811 Date: 4/8/14

*Supervisor should finally encircle one topic out of three proposed topics and put up for approval before Project Approval Committee (PAC)

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ABSTRACT

Gait recognition has analyzed the persons based on the walking sequence. Proposed paper provides feature vectors that are height, width vectors and angles of a skeleton. When we combined these feature vectors it will be providing efficient classification and recognition. In the first step we use the predefined background subtracted images that are generated by the Gaussian mixture model for extracting the foreground object. The second step is feature extraction where extraction is done for feature vectors of a skeleton. Third step is to reduce dimensionality of a feature vectors using PCA, so as to obtain the normalize feature vectors. Forth step is to make sure that MDA increases the separation between classes and reduces the inner class separation this process can be useful for reduce classification computation and recognize the persons easily.

CERTIFICATE

This is to certify that Katakam Santosh has Completed M.Tech dissertation titled **"An Efficient technique for gait recognition using width vector, angles and mda"** under my guidance and supervision. To the best of my knowledge the present work is the result of his original investigation and study. No part of the dissertation has ever been submitted for any other degree or diploma.

The dissertation is fit for the submission and the partial fulfilment of the conditions award of M.Tech Computer Science and Engineering.

Date: _____

Signature of Advisor

Name: _____

UID: _____

ACKNOWLEDGEMET

I am very grateful to my project guide **Mr. Chirag Sharma,** Asst. Prof. in Department of Computer Science & Technology, Lovely Professional University, for his extensive patience and guidance throughout my project work. Without his help i could not have completed my work successfully. I would like to thank **Mr. Dalwinder Singh**, Professor and Head, Department of Computer Science and Engineering, Lovely Professional University, for having provided the freedom to use all the facilities available in the department, especially the library. I would also like to thank my classmates for always being there whenever I needed help or moral support. Finally, I express my immense gratitude with pleasure to the other individuals who have either directly or indirectly contributed to my need at right time for the development and success of this work.

DECLARATION

I hereby declare that the dissertation entitled, **"An efficient technique for gait recognition using width vector, angles and mda"** submitted for the M.Tech Degree is entirely my original work and all ideas and references have been duly acknowledged. It does not contain any work for the award of any other degree or diploma.

Date: _____

Investigator

Regn. No._____

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CHAPTER 1

INTRODUCTION

Introduction

Recognition means identification of an entity. Since 500BC the biometric methods were started. On that time merchants used to seal the products by using thumb. Later on, In 1920 FBI has started thumb recognition and the face recognition has started in 1964. Eyes, lips, eyebrow were comes under the face recognition. The speech recognition has started in 1970, from 1976 onwards they used iris for Iris recognition. In 1994 palm recognition has started. Now present work is going on Gait recognition. Biometric systems are operating in two modes they are verification (also called authentication) and identification. This Gait recognition was found by Aristotle in 1680's.In gait recognition people can be recognize based on the walk (identification or authentication). In gait recognition consider the association between height and step length of a persons. A special advantage of gait recognition is that, provides efficient results of videos in low resolutions, in that situation remaining biometric methods are not good. Gait recognition mainly used for security purpose, because in this third party involvement is not required. This recognition provides high efficiency for long distance also. This Gait recognition is used in various fields such as medical, clinics, robotics and animated games. Challenges of a gait recognition is wearing different type of cloths, injuries, weight changes, carry any objects .Gait sequence of a person is used to recognize an authoritative person, gender recognition, estimate the mental state of a person, estimation of weight and provide medical assessment, Diagnosis and treatment of gait-related disorders. Gait recognition is capable of different applications in various fields of our society. From observation point of view, Gait recognition is efficient method because it can be perform well at both smaller and larger distance. Gait recognition done by using either model based or model free based. Capturing of a gait sequence and understanding are also very useful in access control, computer game and automation. Recently, this recognition used for gender discrimination. Gait analysis is conventional areas that medical field. It provides efficient results. In any situations above all recognition methods are failed, and then the gait recognition method is better than the other methods.

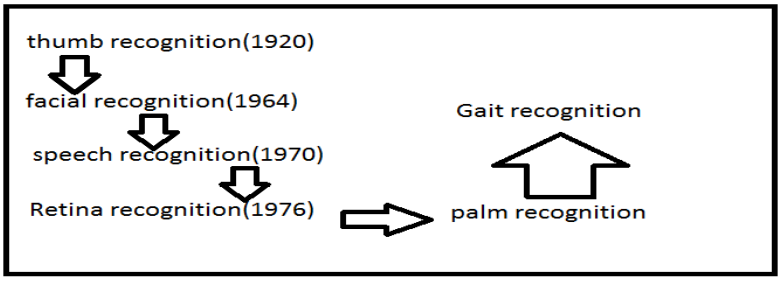

Figure 1: Generations of Recognition

1.1 Process of Gait recognition: This recognition is the multistage process. In this first step was capturing the walking sequence. Most preferably choose the background is uniform, capture the different views of a gait signals that is side view, front view, back view etc. side view provides most information about the gait. After capturing the walking sequence, the walking sequence is separated by using the Background subtraction method. The most important step is future extraction. In feature extraction using the video sequences we can extract the persons walking signals, used for recognition. [14]. There are different methods of future extraction that is using silhouette, contour, skeleton, depth silhouette. Based on feature extracted values classification is done. In classification data can classify using some methods. Based on the classified data recognition is done.

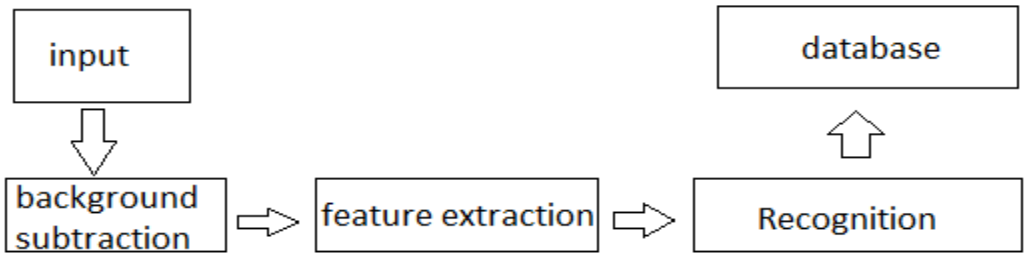

Figure 2: Steps in Gait recognition

1.2 Types of gait recognition: The methods of gait recognition can be divided into two categories holistic (feature/appearance based) and model based (pose based).

I. **Holistic (feature/appearance) based:** This method provide high level processing, computational cost is very low in this method. Time consuming also very less and useful for low resolutions. This holistic method also called as model free based or appearance

based model. This appearance based model is done by using silhouette, contour and depth silhouette. Silhouette means image of a person viewed dark shape in one color and contour means outline of silhouette represented in line.

a. **Silhouette:** It is the image of a person viewed as dark shape in on color. It can be used in recognition purpose.
b. **Contour:** Outline of a silhouette is called as contour. It can be used in many techniques for recognition.
c. **Depth silhouette:** Depth silhouette means every pixel represent the calibrated distance in meters from sensor (no color or texture).

II. **Model based (pose based):** Model based method provide high level processing. This method provides high accuracy but required high quality of images. Model based method is done on static and dynamic body parameters. Model based method done by using pose estimation and skeleton.

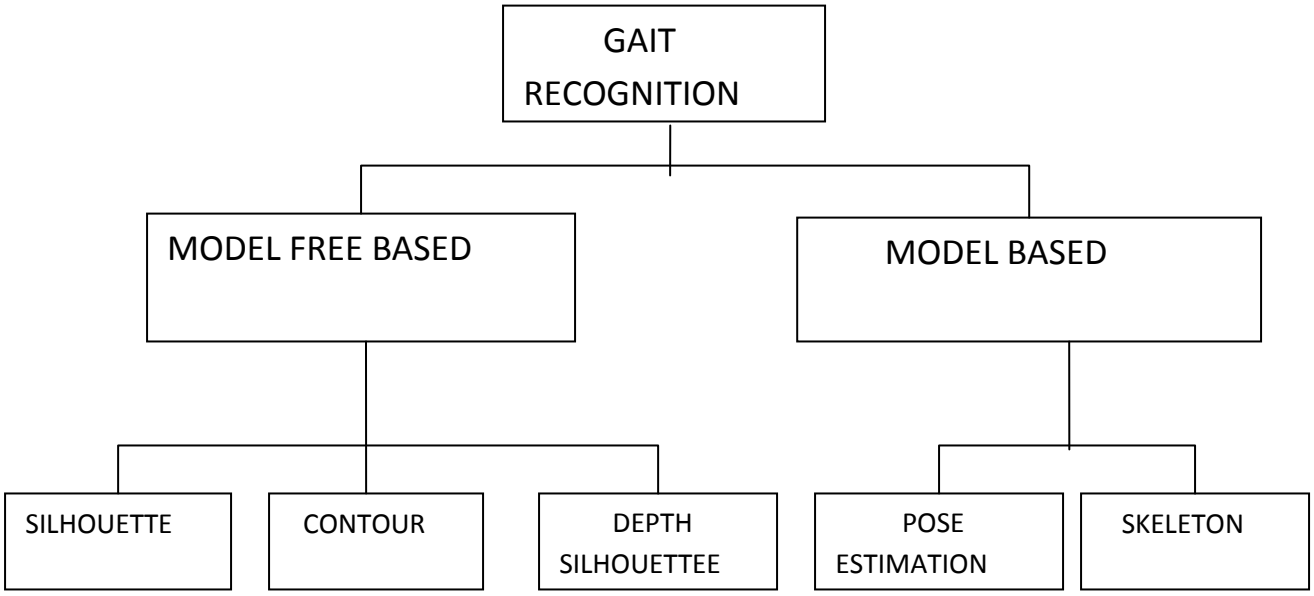

Figure 3: Types of gait recognition

1.3 Methods in gait recognition

a. **Machine vision**: Obtain single view images with a frame by frame approach. Most of the machine vision based gait recognition algorithms are based on the human silhouette. Silhouette means image of a person viewed as dark shape in one color Machine vision can be used in surveillance and forensics applications.

b. **Wearable sensor: S**tored the individual gait by using body warm motion recording sensors. The motion recording sensors placed on the human body at different locations. The acceleration of gait is recorded by the motion recording sensor, is used for authentication. These wearable sensors used in mainly medical field. Mobile phones also used in applications such as m-commerce and m-banking.

c. **Floor sensor:** These sensors are fixed under the ground and gait related features are measured as a person's walk on it. This sensor based recognition provide identity information. The floor sensor based gait system can also indicate location information within a building.

d. **Continuous wave (radar)**: Identified based on the Doppler signature .The Doppler signature is unique to each person. Different body parts give different unique Doppler signature belonging to the individual only.

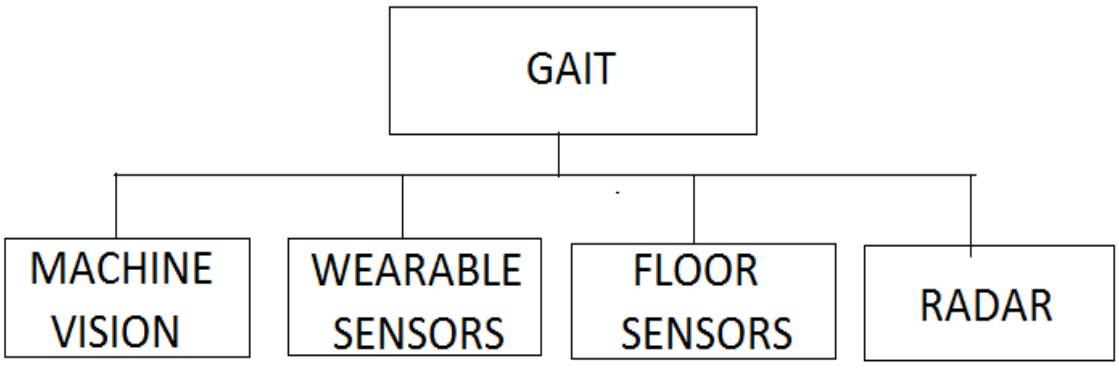

Figure 4: Methods of gait recognition

Because of its several limitations, gait technology has yet to be commercialized.

1.4 Challenges: Gait affected by some factors they are:

a. **Different clothing's:** people wear different types of clothes, difficulty in analyzing the gait signals. This is the main problem recognizing through videos. Or images.

b. **Carrying bulky items:** If any persons carrying of any items cctvs doesn't capture the proper video. This can be affected on recognition.

c. **Physical injuries:** Any people loss their legs in accident or any disease or some other reasons. In that situation this recognition fails.

1.5 Improvement methods

a. **Face and Gait**: Face required front profile, gait recorded side profile. 3d models of the person should be created. 3d models will allow face and gait recognized at the same time. Both face and gait will increase accuracy to 100%. However 3D models are hard to construct.
b. **Radar and machine vision:** Each person have unique Doppler wave. This can be measured using radar. Measurement is continuous & quantifiable in machine vision**,** this method many single frame images have to be processed.
c. **Building a database:** In this data how injuries affect a person should be included in the database. Different emotions affect how a person walks. More statistics better cross referencing.

1.6 Applications of gait recognition

a. **Security:** gait recognition used in security because they have special properties that is .Non invasive nature, Third Party Corporation is not required, provide high efficiency over the long distance also. This gait recognition used for Guard against terrorism and domestic crimes and Improve security in airport embassies and military. Gait recognition used in shopping malls and companies also. An innovative tunnel by each application. In this record an individual gait and then criminals can be made to walk through these tunnels to record their data within the data bank for easy identification respect their crimes. Can also be shared between countries to avoid crimes. Detect suspicious behaviour even before a crime is committed. Problem with cctvs, large number of people moving in and out buildings every day, difficulty to security guards to find the suspicious characters, hence we use the gait recognition allow identity association of matching the databases. Recently in Sweden after the bank robbery, the cctv images are not clear in that situation police use the gait patterns and caught the thieves.
b. **Medical and Clinical:** In medical field used to identify affect the motor capabilities of a person such as in Parkinson's disease. In Early identification allow treatment and therapy to be prescribed earlier. Motion analysis uses gait technology has been applied in preparative planning for treatment of cerebral palsy. In clinical used for planning

treatments and collect data on patients gait during checkups. Gait recognition used in gender recognition also.

c. **Sports:** Using the gait recognition the athlete's performance and analyzed areas of improvements. Prevent sports injuries that are incorrect posture, sprains and strains. By placing wearable sensors on body segments collect the data and sometimes floor sensors also uses. Provide efficient improvements Athletes.

d. **Robotics:** gait analysis can be used in create of walking robots, where achieve constancy and maintain strength, on various areas like climbing, walking, running. Walking style of robots is very important that's why using the gait we solve the problem.

e. **Games:** Gait approach is used in the multimedia and games, in these areas appearance of persons walking is useful. While play the games walking of a person's was not realistic, no one can interest play that games.

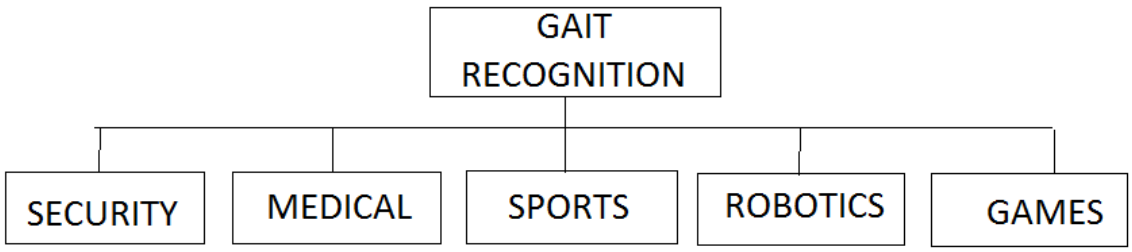

Figure 5: applications of gait recognition

1.7 Techniques in Gait recognition

I. **Support Vector Machine (SVM):** In this scheme analyze the data and recognize the patterns. This was one of the supervised learning models. It's mainly used for classification and regression analysis. This support vector machine will helps to classify the data. In machine learning concept this will be used mostly. The research is going more on svm. Example for svm: Suppose if a Person typing a mail and sends to any other person that message will be stored in his inbox how it is storing? Using svm the machine will classify the data in efficient way. This svm method is most commonly used in machine learning methods to make a decision and classify the data.

a. **Weakness:** This method provide insightful in noise. Use less examples can easily reduce the efficiency. Not easy to incorporated domain knowledge and svm taken long training time. In svm Difficult to understand the learned functions.

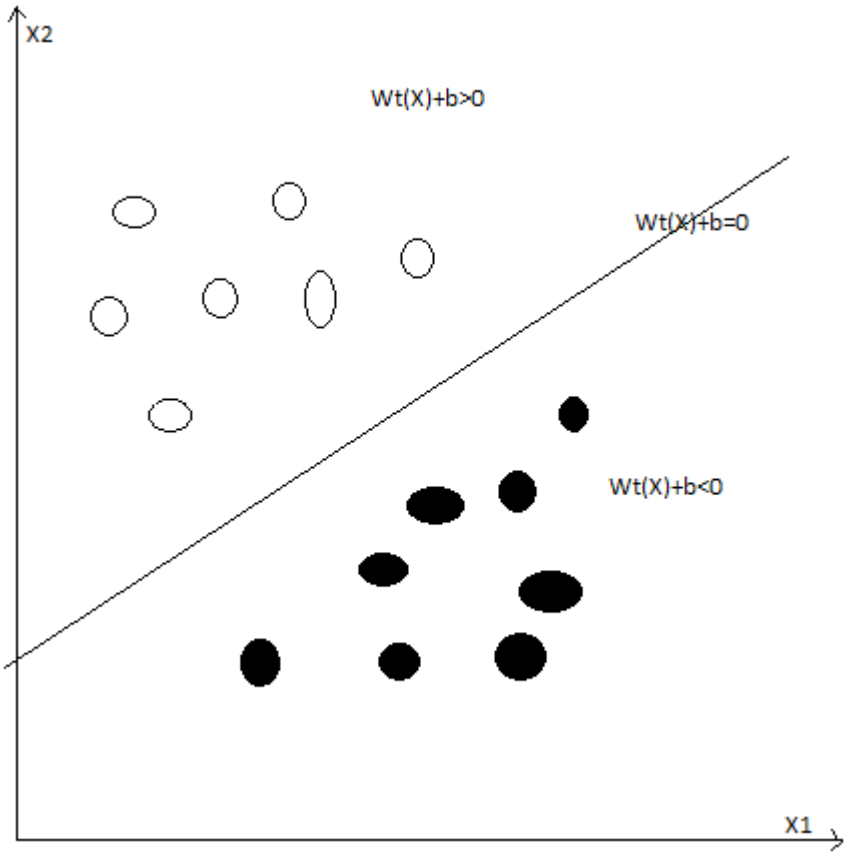

Figure 6: Support Vector Machine

II. **Hidden markov model (HMM):** The hidden markov model used for classification purpose in the gait recognition. Hmm uses three algorithms that are model evaluation, probable path decoding and model training. The model evaluation done by using forward and backward algorithm. In this forward algorithm find out the goal based on the data and backward algorithm is the reverse process of a forward algorithm. Path decoding done by using state sequence or optimal path or verbi algorithm.

a. **Strengths:** The main strength of a hidden markov model is compression and these models are fairly readable. The hmm can be merge with recognize sequence of structures.

b. **Weakness:** The hidden markov model has two types forward and backward, but these two methods are more expensive. This method quit slow because in this method must to

find all possible solutions. There are many possibilities for different hmm, choose one of them is so difficult.

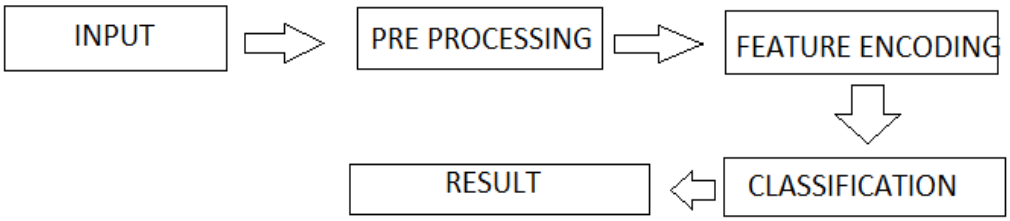

Figure 7: Steps in hidden markov model

III. **Principal Component Analysis:** This method is used to find the patterns. Based on that it easily expresses the data. Then highlight their similarities and differences. It is very difficult to find patterns in a high dimensional area where there is no chance of occurring luxury graphical representation, this process efficient tool for analyze the data. PCA is mainly used for image compression, because in pca found the patterns in data then dimensionality reduce without data loss. [10].By considering the values of mean and variance dimensionality can be minimized. It is efficient technique that can be used in various fields that is face recognition and image compression. This process can use for express the high dimensional data. This method useful, if classification used for mda because these two methods follows same process. It can use for classification also using kernel principal component analysis.

a. **Strengths:** Principal component analysis is performed well. In each class contain very less training samples. Compute a vector that has variance associated with it. Used in Analysis of meta-bolomics data. It can be useful in mainly Gait recognition, in this recognition process dimensions are so high in that situation we use pca for dimensionality reduction.

b. **Weakness:** This process uses vectors of mean and covariance matrix of data, some totally depend on it. It is not a scale invariant. In principal component analysis dimensionality reduction can achieve original values are correlated. If values are uncorrelated principal component analysis does nothing.

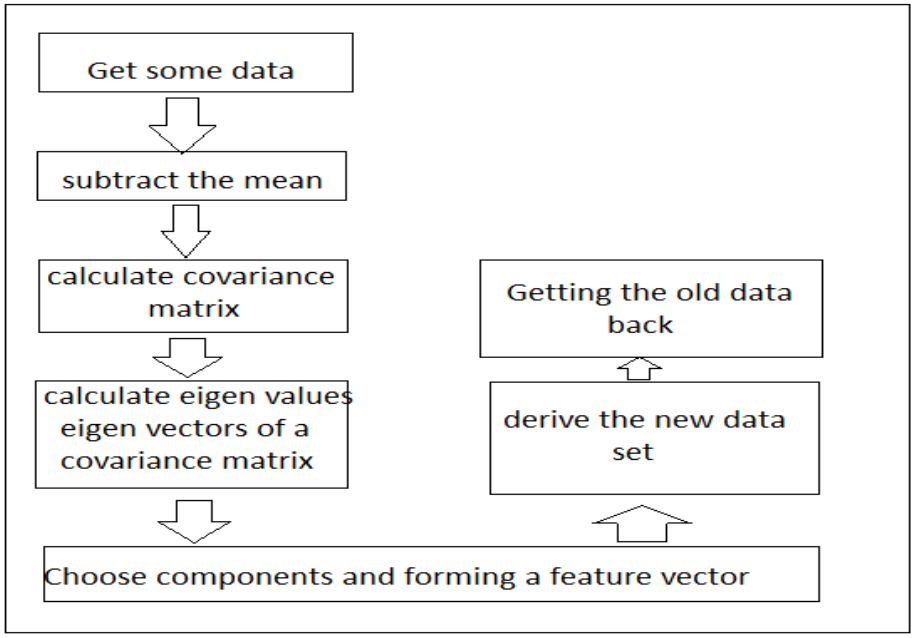

Figure 8: Principal component analysis

IV. **Linear Discriminant Analysis:** It provides best separation of classes. It performs good when training set is large. Linear Discriminant Analysis mainly deals with the inter class frequencies where they are not equal and their performance analysis can be maintain on the used data perform random. It provides increases the variance in between and within classes of any data set, used for maximize separation in data. It can be provide more separation of classes. If any process contains not complex information in that situation it works efficiently. It can be useful in mainly Gait recognition, in this recognition process dimensions are so high in that situation we use pca for dimensionality reduction.

a. **Strengths:** This method find the vector with best discriminates with different classes. Lda performs well when the large and representative training data set is used.lda optimal classes are Gaussian and have equal covariance. Mainly if data contains so useful information prefers linear discriminant analysis.
b. **Weakness:** This method fails if data contain complex structure of data, it can be use for classification. This process not perform well if data in men not in variance. It cannot be useful in recognitions because every recognition method rate totally depend on the complex structures in that situation it fails.

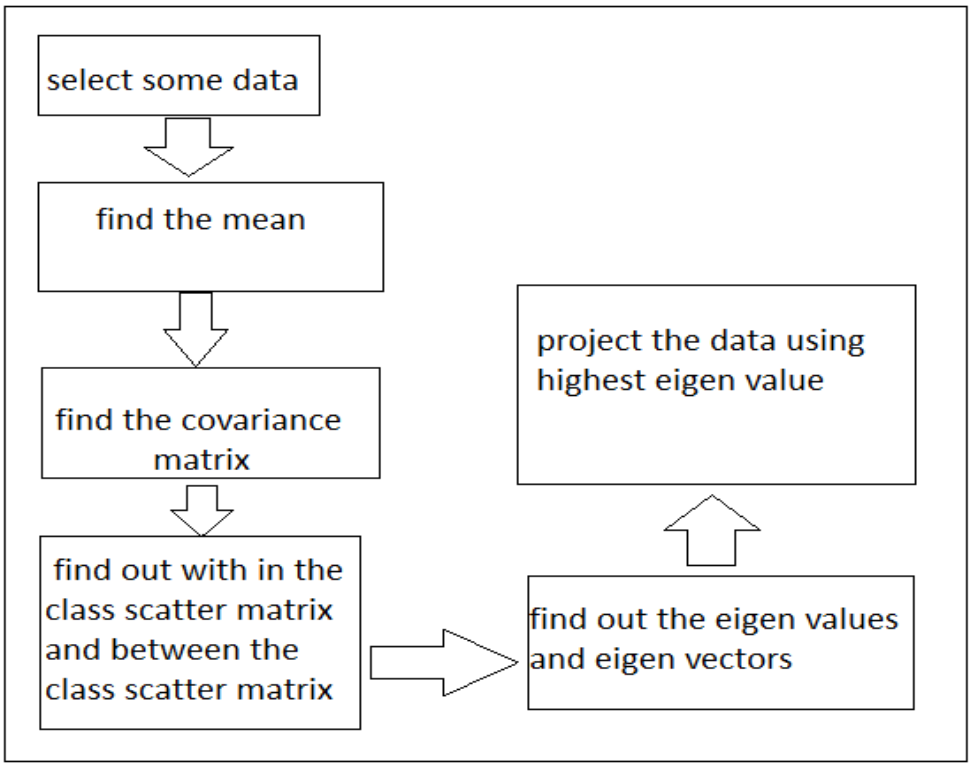

Figure 9: Linear discriminate analysis

V. **Back Propagation Neural Network:** This method is the one of the feed forward neural network. It can be mainly used for classification purpose. In this method find out the error value of a hidden neurons.

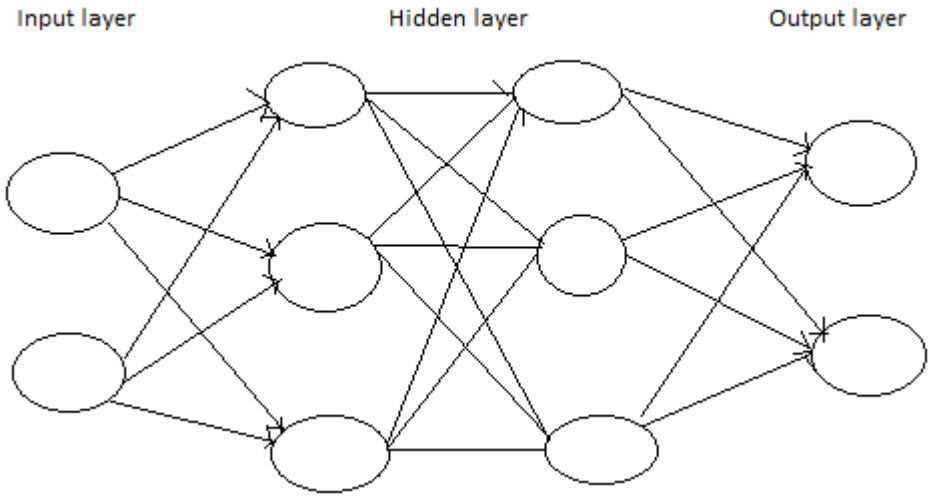

Figure 10: Back propagation

a. **Weakness:** This method provide insightful in noise. Use less examples can easily reduce the efficiency. Not easy to incorporated domain knowledge and bpnn taken long training time. In bpnn difficult to understand the learned functions.
b. **Strengths:** This method can useful for data contain small. Provide a good method for parallel computation in any areas. This method can perform similar like digital computer can do.

CHAPTER 2

REVIEW OF LITERATURE

Review of literature

Lindsay I Smith (2002) conducted a Survey on Pca. In this presentation mainly he described about the principal component analysis. Then background mathematics like calculation of mean, variance and standard deviation. And step wise how they dimensionality reduce in principal component analysis, its applications, Strengths and weaknesses. In this explain step Wise calculation of Eigen values and vectors, and explain how they separate the data in efficient way. This paper mainly focuses on the low dimensional data. In this method mainly focus on separation of classes and reducing the dimensionalities.

Mark S.nixon John N.carter (2003) conducted a Survey on Automatic recognition by gait progress and prospects. He explains about how the gait recognition will work efficiently using large database. This database allows inner and two classes of variance. This technique used in silhouette based analysis. And explain the model based and model free methods. In this paper explain why we use that gait recognition and which areas it can used. What are the improvement methods and how they implement in real time, explain which parameters are used to implement the gait recognition. This paper mainly focus on the feature extraction methods that are model based and model free based.

Liang Wang, Tieniu Tan, Senior Member, IEEE, Huazhong Ning, and Weiming Hu (2003) conducted a Survey on Silhouette Analysis-Based Gait Recognition for Human Identification. In this paper they did gait recognition algorithm by using spatial-temporal silhouette analysis. In this algorithm they use principal component analysis for dimensionality reduction. This algorithm used to find the parameters of gait and proposed a new integrated background subtraction procedure. In feature extraction analyze the silhouette boundary converted into single dimensional that provides less cost. Mainly explain about the principal component analysis and spatial temporal analysis. PCA provides efficient dimensionality reduction for model based approaches.

Mingyue Tan (2004) conducted a Survey on Support Vector Machine & Its Applications. In this presentation they explain about support vector machine, linear and nonlinear support vector machines. How they classify the data using support vector machine and its Applications, strengths and weaknesses. In this paper explain about the scheme analyze the data and recognize the patterns. This was one of the supervised learning models. Mainly used for classification and regression analysis. In this paper mainly focused on the classification that's why they used svm for classification of model free based approaches.

Nikolaos V. Boulgouris, Dimitrios Hatzinakos,and Konstantinos N.Plataniotis (2005) conducted a Survey on Gait Recognition: A challenging signal processing technology for biometric identification. In this paper he described about the generic gait recognition and its approaches like model based and model free based. Explain different types of classification techniques using silhouette and non biometric applications of gait. In gait recognition consider the association between height and step length of a persons. A special advantage of gait recognition is that, provides efficient results of videos in low resolutions, in that situation remaining biometric methods are not good. But in this paper does not use the dimensionality reduction methods. If database increases dimensionality reduction methods provide less computational cost.

Sung-Jung Cho (2005) conducted a Survey on Introduction to Hidden Markov Model and Its Application. In this presentation he described about hidden markov model and sequential data. He Explain how classify the data using hidden markov model. It provides applications of sequential data and hidden markov models. Hmm uses three algorithms that are model evaluation, probable path decoding and model training. Model evaluation is done by using forward and backward algorithms. In this forward algorithm find out the goal based on the data and backward algorithm.

Dong Xu, Shuicheng Yan, Dacheng Tao, Lei Zhang, Xuelong Li, and Hong-Jiang Zhang (2006) conducted a Survey on Human Gait Recognition with Matrix Representation. In this paper they explain about Gait recognition using couple space analysis and discriminant analysis with dater matrix representation. In this csa used for remove noisy and dater used for improve ability of a classification. In this paper explained about overall accuracy of gait recognition how they increases and decreases using matrix representation. Also explain about

how they efficiently feature can be extracted and classify the data. This paper mainly focuses on the feature extraction and classification. But not focus on the dimensionality reduction and low frame rate videos.

Davrondzhon Gafurov Gjovik University (2007) conducted a Survey on A Survey of Biometric Gait Recognition: Approaches, Security and Challenges. In this paper he explains about the different types of user authentication process, and gait recognition that is recognition of people by their gait. He also explains about different techniques involved in the gait recognition. Explain what are security challenges and approaches. Explain how gait recognition used for Guard against terrorism and domestic crimes and Improve security in airport embassies and military. Gait recognition used in shoppingmals and companies also. In this record an individual gait and then criminals can be made to walk through these tunnels to record their data within the data bank for easy identification respect their crimes.

Aly A. Farag Shireen Y. Elhabian CVIP Lab (2008) conducted a Survey on A Tutorial on Data Reduction. In this presentation he described about the PCA and LDA. Then explain about step wise how they dimensionality reduce in PCA, and LDA its applications. And explain how they calculated mean, variance, standard deviation in the given data set. It is very difficult to find patterns in a high dimensional area where there is no chance of occurring luxury graphical representation. PCA performs well compare to the LDA where training samples is less. LDA fails if discriminate information not in the mean but in the variance.

Lili Liu , Yilong Yin _,Wei Qin , Ying Li(2011) conducted a Survey on Gait recognition Based on Outermost Contour. In this paper he described about recognition done by using outermost contour. In this pca used for dimensionality reduction .They use three classification techniques like mda, bpnn and svm. Finally he find out the best classification method that is MDA. In this paper feature extraction based on contour that is find the distance values. Then reduces the data size and efficiently classify the data.

K.B. Low, U.U. Sheikh (2013) conducted a Survey on Gait Recognition Using Local Ternary Pattern (LTP).In this paper they described about local ternary pattern using gait recognition. Ltp mainly used for texture classification problem. In this 2d joint histogram of

an ltp is computed then use nearest neighbour for recognition. This method will improve overall accuracy and robustness. It provides new approach for recognition efficient manner. This LTP used in mainly face recognition. In this paper image can divided into sub parts then extract the feature values.

CHAPTER 3

PRESENT WORK

Present work

i. The work has completed till feature extraction, recognition of the background subtracted images. We have worked on the predefined background subtracted images and got the efficient results. This process has implemented in the Matlab.
ii. In feature extraction we found the width, height and angles of the skeletal of a person's image, it used for efficient classification. Therefore PCA used for dimensionality reduction.
iii. Recognition rate and time values are calculated for the Different walking sequence of persons. Recognition rate totally depends on the walking sequence. Finally we achieved good classification rate and time.
iv. In this we use multi view data base(walking from left to right, walking from right to left and cross walking) it will provide efficient recognition. Correct recognition of persons has done efficiently by using different view.

3.1 Scope of the study

i. The proposed algorithm provides two feature vectors that is combination of width, height vector and angles of a skeleton. Gait recognition depends on feature extracted values. If we extract more feature values then recognition accuracy will increase.
ii. The proposed system provides efficient recognition of different view of persons. This method can be used in security and surveillance purpose.
iii. PCA for reduce the dimensionality. The feature values are high size in that situation classification is difficult to overcome that situation we use PCA for dimensionality reduction.
iv. In the proposed system MDA for classification, using this MDA reduce the separation of interclass's, increase the separation of between classes. This is useful for classification.

v. The proposed system works on multi view database that is useful for recognition. If multi views are used one feature vector is not sufficient. That why proposed system uses the two feature vectors.

3.2 Problem formulation

Gait recognition has been using in many areas. Gait recognition has been popular topic for both researches and applications in the last 10 years. Now a day's recognition technology has been grown very fast and for efficient recognition, need some special mechanisms like gait recognition. Gait recognition is done based on the walking sequence (walking from left to right, walking from right to left and cross walking) of persons. The proposed method used the multi view database of a background subtracted images. But the problem with the existing system is a single view database and it uses a single feature vector, it is not sufficient for efficient recognition. My problem is a hybrid approach which consist two feature vectors width, height and angles of the skeletal of a person's image and which are provide the useful data for efficient recognition. In this case we have calculated recognition rate of different views (walking from left to right, walking from right to left and cross walking) and time values. Proposed method uses multiple views, therefore it provides maximum correct classification rate.

3.3 Objectives

i. To focus on feature extraction and classification, because based on the feature values recognition process will be done. After feature extraction classification is the main approach.
ii. Efficient recognition provides best recognition rate and time values of a different views (walking from left to right, walking from right to left and cross walking) of a person.
iii. In existing system feature extraction done by using outermost contour. It provides best feature values for classification purpose. It uses PCA for dimensionality reduction.
iv. Existing system uses MDA and ENN for classification purpose. It provides good accuracy. Weakness of an existing system is extract only one feature vector for classification purpose and uses single view database only.

v. To improve the accuracy of recognition, the proposed algorithm uses two feature vectors that is combination of width, height vector and angles of a skeleton of an image. Gait recognition depends on feature extracted values.
vi. Proposed algorithm helps us to improve efficient recognition over a multiple views.

3.4 Research Methodology

The methodology presents in this proposal is to achieve the research is the hybrid approach. This approach presents the mixture of descriptive and exploratory methodologies. These two approaches are useful to achieve the good results in the research. The Exploratory approach is used for collecting the information about the techniques which are using in the Gait recognition. From the above approach the collecting data will help to achieve good Gait recognition techniques. Descriptive analysis is used to achieve the problems in the existing system it provides some methodology which help in solving the problems which are defined by the researcher. Descriptive and Exploratory approaches are used to solve the any type of problems which were produced by the researchers in the real world.

Gait recognition is done based on the walking sequence (walking from left to right, walking from right to left and cross walking) of persons. The proposed method used the multi view database of a background subtracted images. But the problem with the existing system is a single view database and it uses a single feature vector, it is not sufficient for efficient recognition. My problem is a hybrid approach which consist two feature vectors width, height and angles of the skeletal of a person's image and which are provide the useful data for efficient recognition. In this case we have calculated recognition rate of different views (walking from left to right, walking from right to left and cross walking) and time values. Proposed method uses multiple views, therefore it provides maximum correct classification rate. Our proposed method totally depends on the skeleton of an image. If we extract exact values of skeleton then recognition rate increase. Dimensionality reduction also main task in our problem because of that reason proposed method uses pca for best dimensionality reduction.

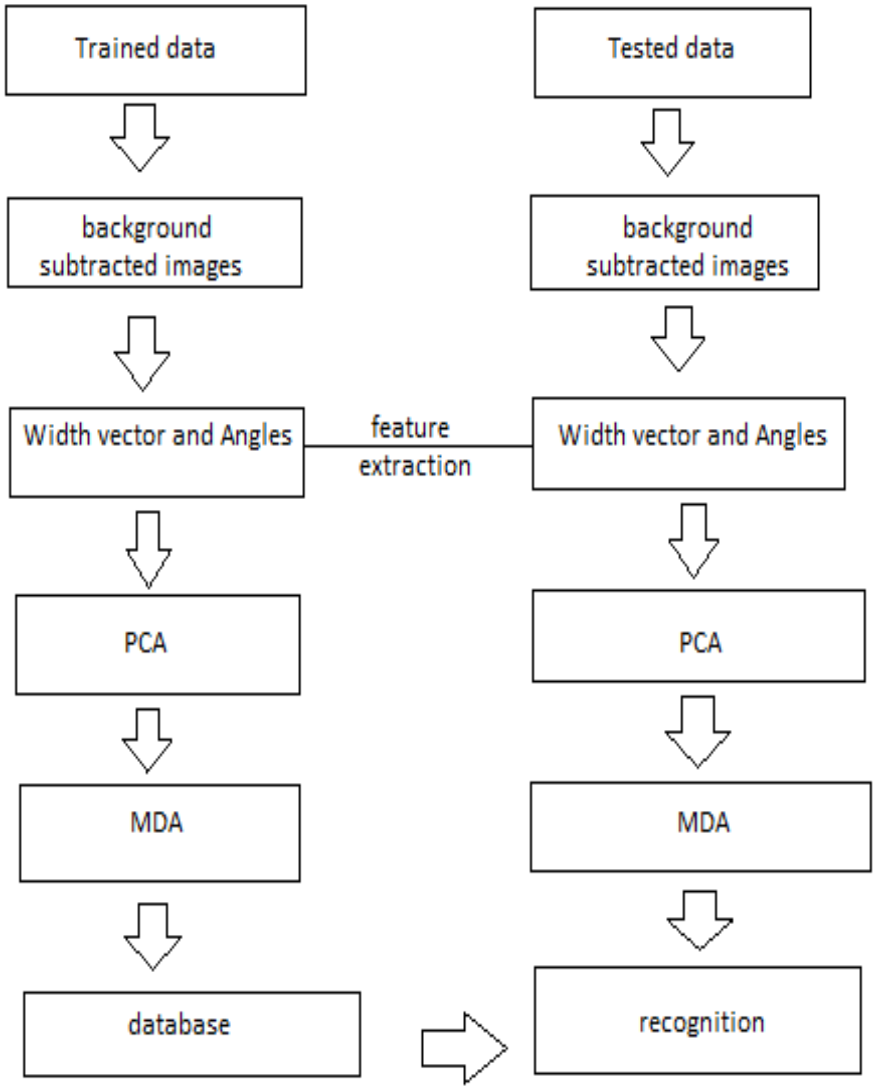

Figure 11: Recognition Process

I. **Silhouette representation**: This is the starting step of our proposed system. We use the predefined background subtracted images that is Gaussian mixture model for extracting the foreground object.

II. **Feature Extraction**: Feature Extraction means transform the data into set of feature values. Over all gait recognition accuracy depend on Feature vector values. In this proposed system first we perform the skeletalization after that we extract two types of feature vectors that is width, height vectors and angles.

a. **Width and height of a skeleton:** The most left pixel and most right pixel distance of skeleton gives the width of the vector. Simply width of the vector means difference between left and right most pixel values in a row by row and based on that find out the height of a skeleton.

b. **Angles of a skeleton:** In this process based on the skeleton we find out the different types of angles of a skeleton.

In proposed system extract the feature vectors that are height, width vectors and angles of the skeleton.

III. **Principal component analysis:** The main task of this is to finding the various patterns and expresses the data. The dimensionality of a signal distance has large distance so PCA is used to reduce the size.

Signal distances Dij, Ni is the number of distance signals at I th class.

Step1. Find the mean

$$md = (\frac{1}{nt}) \sum_{1=1}^{c} \sum_{j=1}^{ni} Di,j$$

Step2. Find the covariance matrix

$$\sum \quad = (\frac{1}{NT}) \sum_{i=1}^{c} \sum_{j=1}^{ni} (Di,J - md)(Di,j_{md})T$$

Step3. Calculate k dimensional Eigen space by using this formula

$$pij = [e1, e2, e3, en]tDij$$

Step4. Find the centroid for all pij values.

$$ci = i/n \sum_{j=1}^{ni} pi,j$$

Centroid of an unit vector is ui= (ci/‖ci‖). This unit vector gives the gait feature for each sequence.

IV. **Multiple Discriminant Analysis:** MDA solves the classification problems in multiple classes. MDA reduces the separation of classes. MDA provide efficient class separation for the gait recognition. Suppose the n k-dimensional gait features u1,u2,_,_,un, belong to *c* classes.

Step1. Find With in the class scatter matrix sw

Sw=$\sum_{i=1}^{c} si$

Step2. Between-class scatter matrix *S B* are defined as

$Sb = \sum_{i=1}^{c} ni(mi - m)(mi - m)t$

In MDA increase the separation of between classes and decrease the separation of within

Step3. Then we find the Transformation matrix

$j(W) = (WtSbW)/(WtSwW)$

Step4. We obtain the Eigen vectors of the transformation matrix. These Eigen vectors are used for calculation of Feature vectors.

$Fi = [v1, v2, --, ve - 1]T\ ui$

Based on the final feature vector recognition is done. First we extract the feature vectors. Then pca reduces the dimensionality. After that mda classify the data.

CHAPTER 4

RESULT AND DISCUSSION

Result and discussion

This proposed algorithm has implemented in the Matlab. The proposed method used the predefined background subtracted images that is walking from left to right, walking from right to left and cross walking. In the three walking cases it provided good results of recognition and time. We have also observed that the proposed algorithm also provides the efficient recognition. This proposed algorithm has applied on the predefined background subtracted images.

4.1 Walking from left to right

First we track the walking sequence of the person that is walking from left to right (figure 12). Next step was feature extraction in this based on waking sequence we find out the skeleton of persons silhouette (figure 13). Then we obtain the angles of the skeleton (figure 14), these feature vector values (figure 15) useful for efficient recognition. Based on these values we find the gait cycle of a walking sequence of a person (figure 16). After that perform recognition based on the final feature values (figure 17).

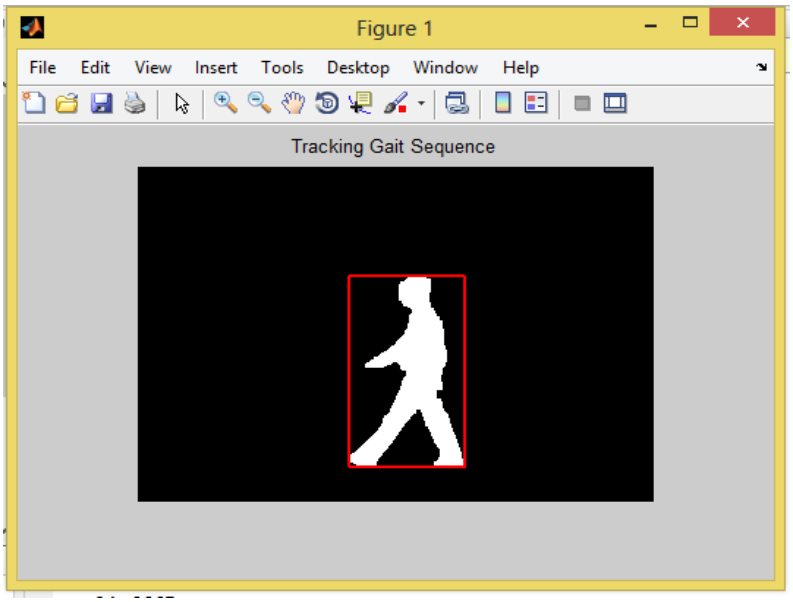

Figure 12: Tracking Gait Sequence (walking from left to right)

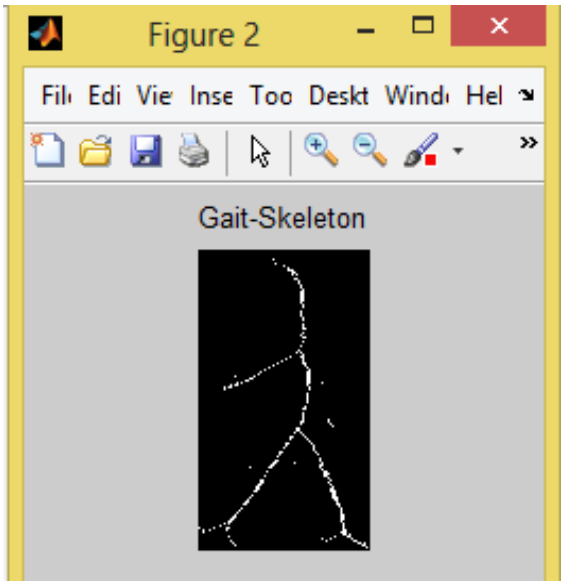

Figure 13: Gait skeleton

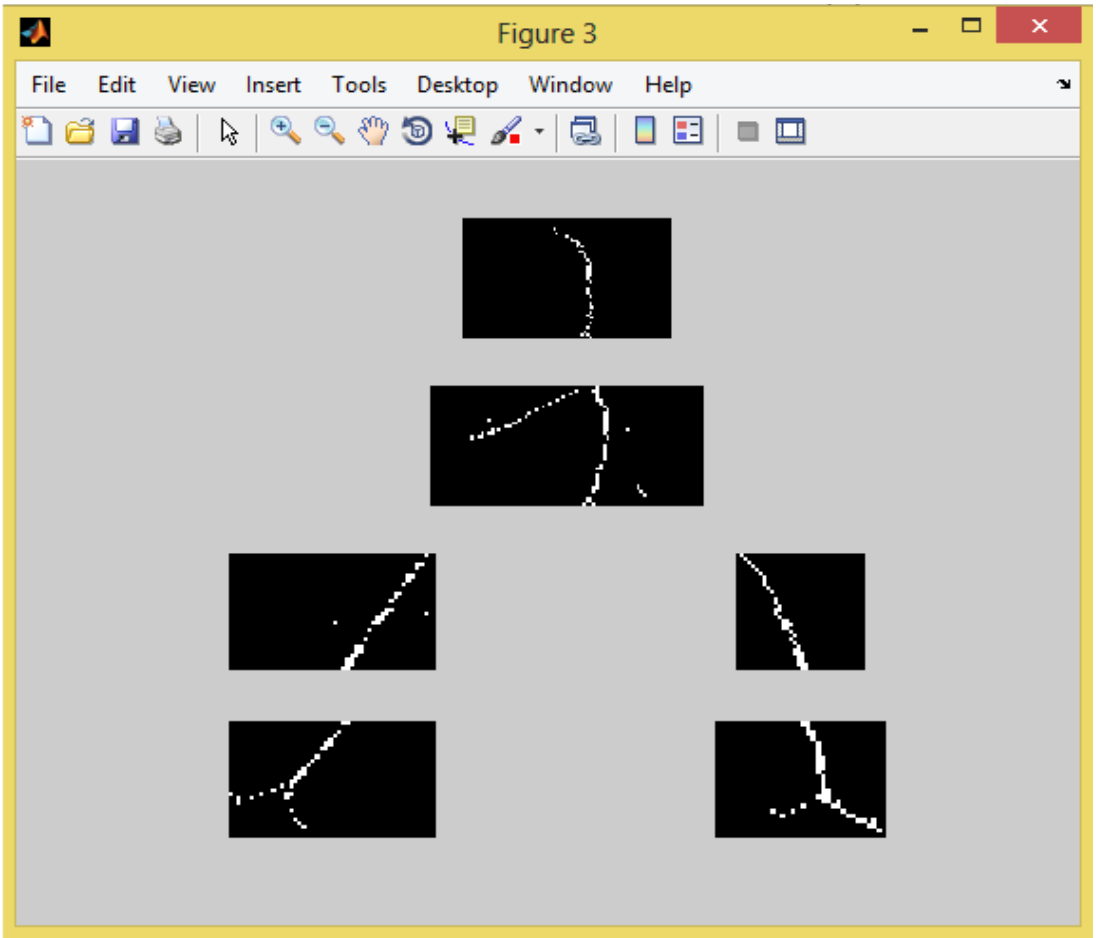

Figure 14: Angles of skeleton

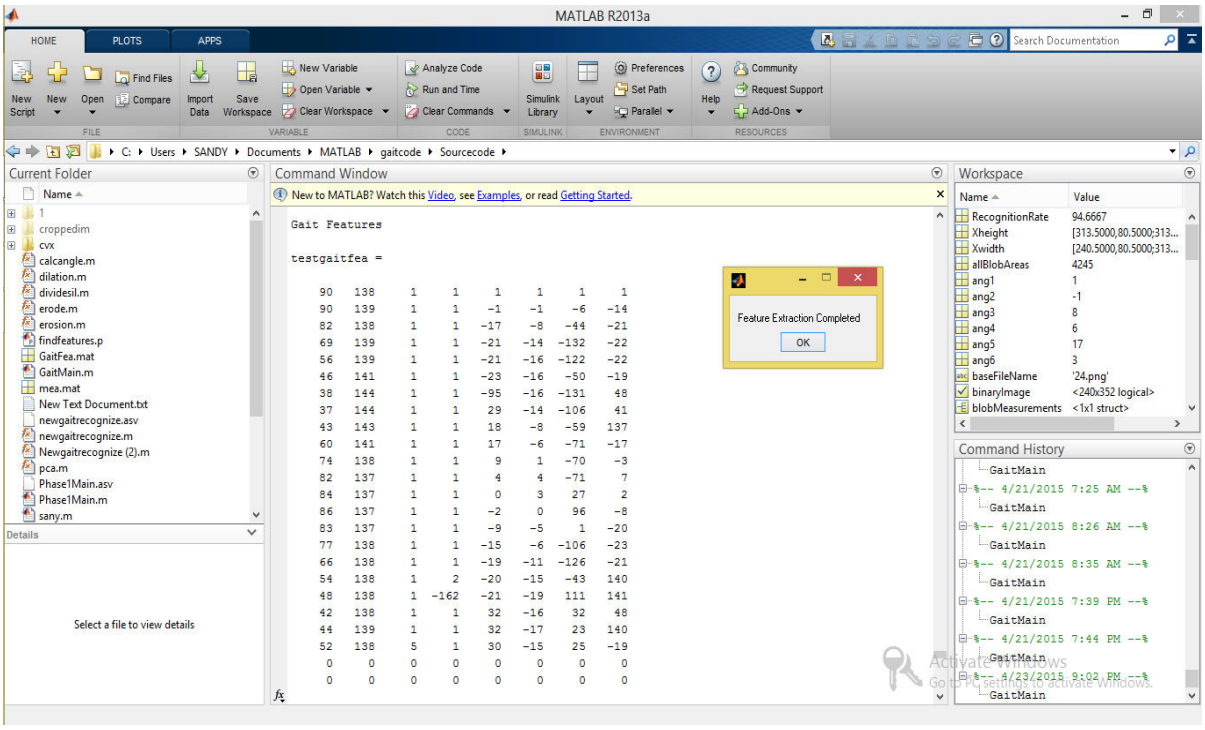

Figure 15: Gait Features

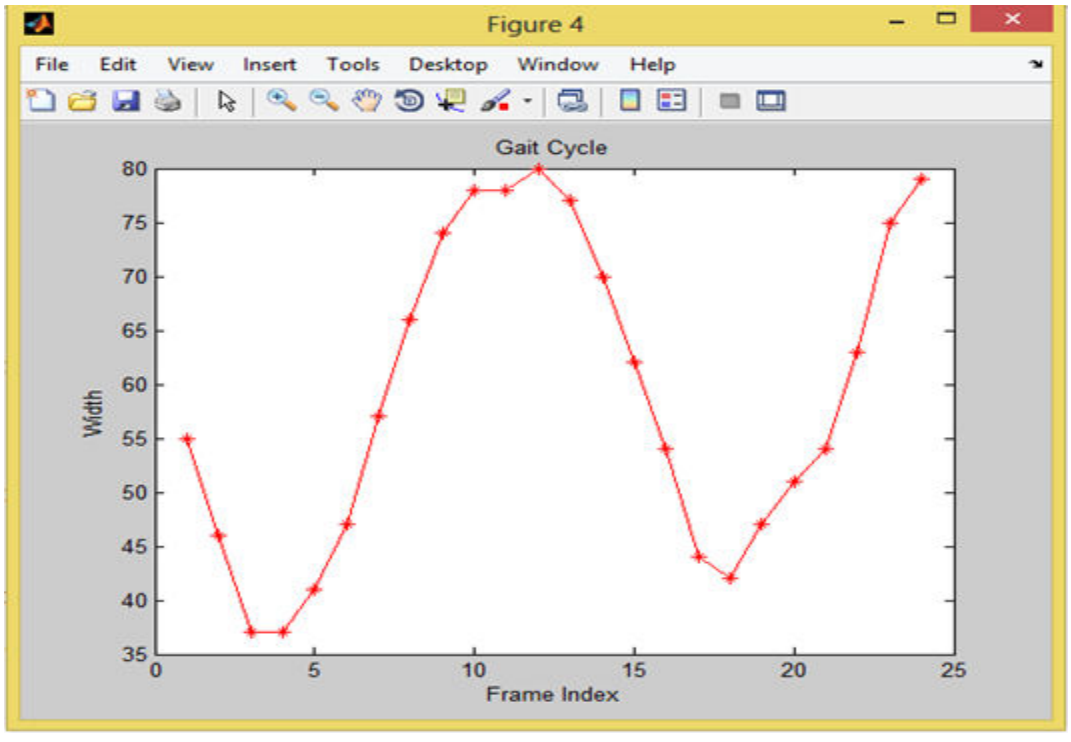

Figure 16: Gait Cycle

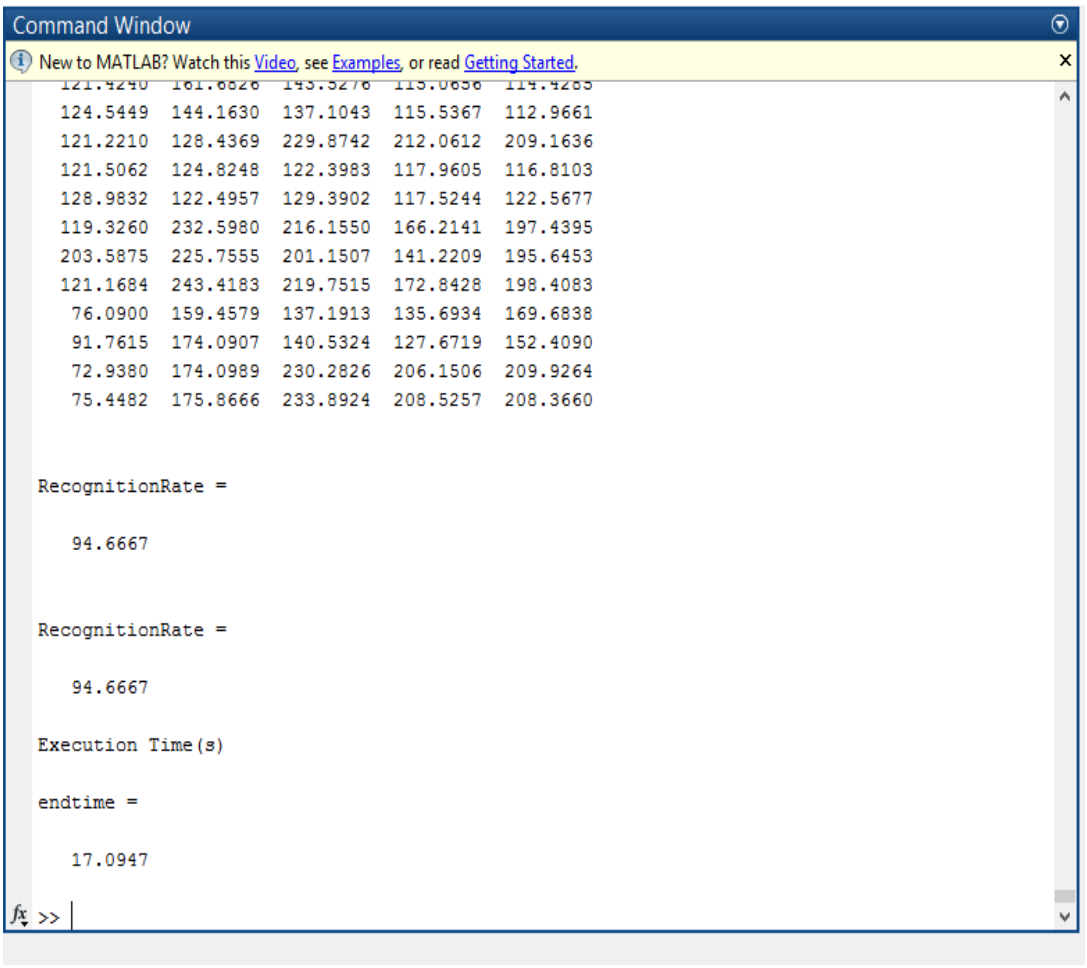

Figure 17: Recognition Rate and Time

The above results show that proposed system provides efficient recognition rate and time.

4.2 Walking from right to left

First we track the walking sequence of the person that is walking from right to left (figure 18). Next step was feature extraction in this based on waking sequence we find out the skeleton of persons silhouette (figure 19). Then we obtain the angles of the skeleton (figure 20), these feature vector values (figure 21) useful for efficient recognition. Based on these values we find the gait cycle of a walking sequence of a person (figure 22). After that perform recognition based on the final feature values (figure 23).

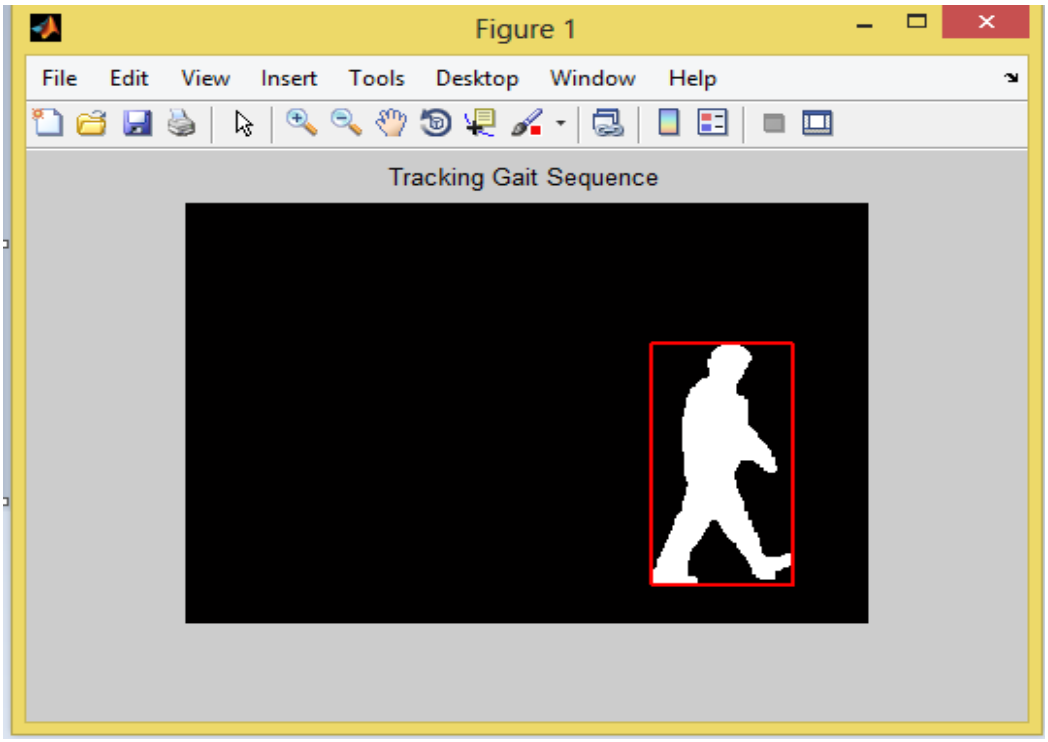

Figure 18: Tracking Gait sequence

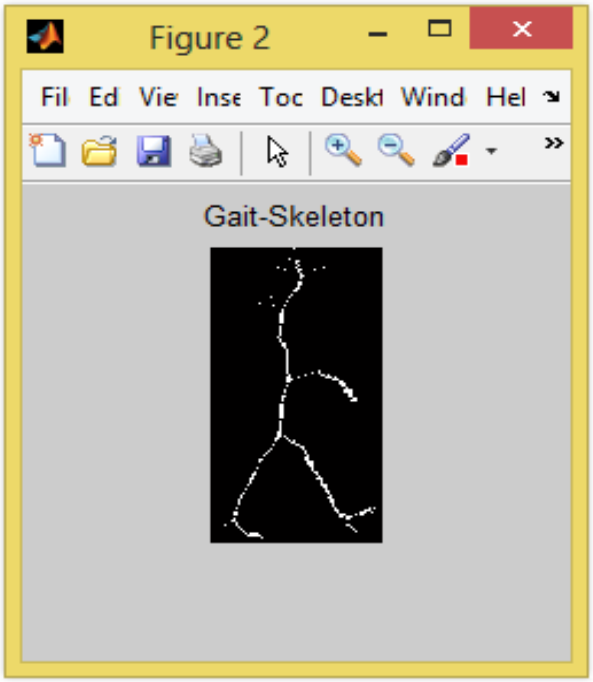

Figure 19: Gait skeleton

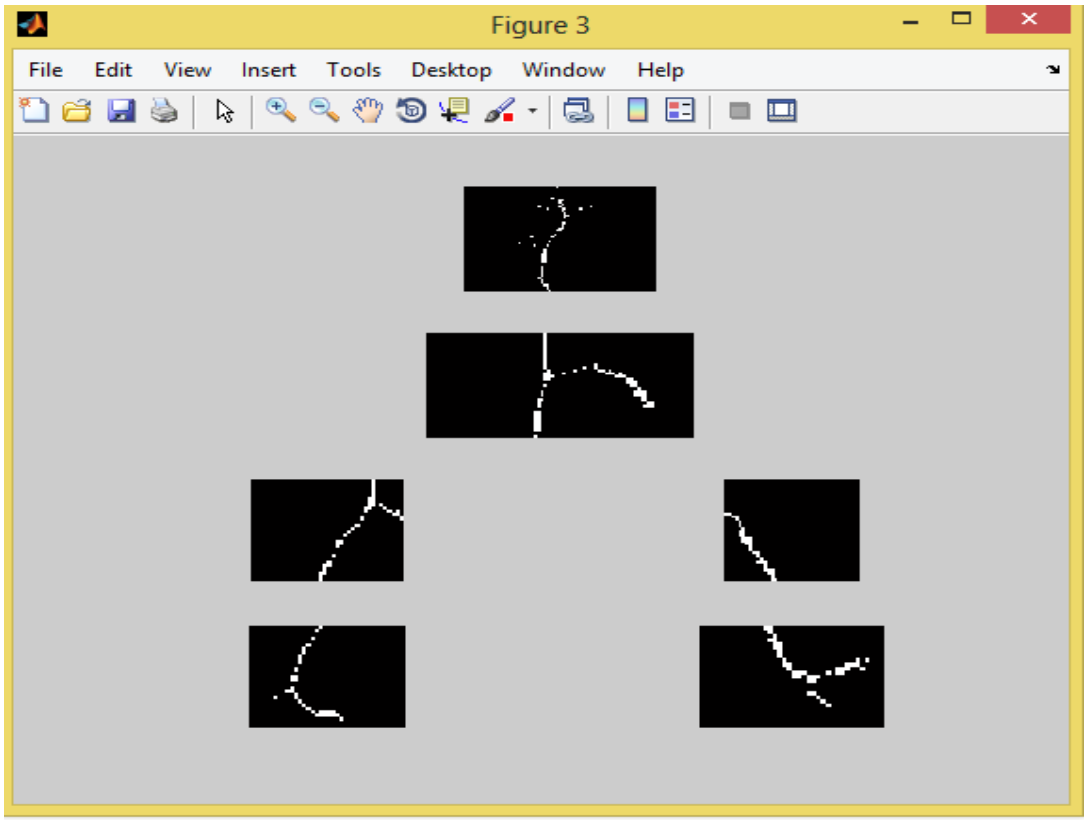

Figure 20: Angles of skeleton

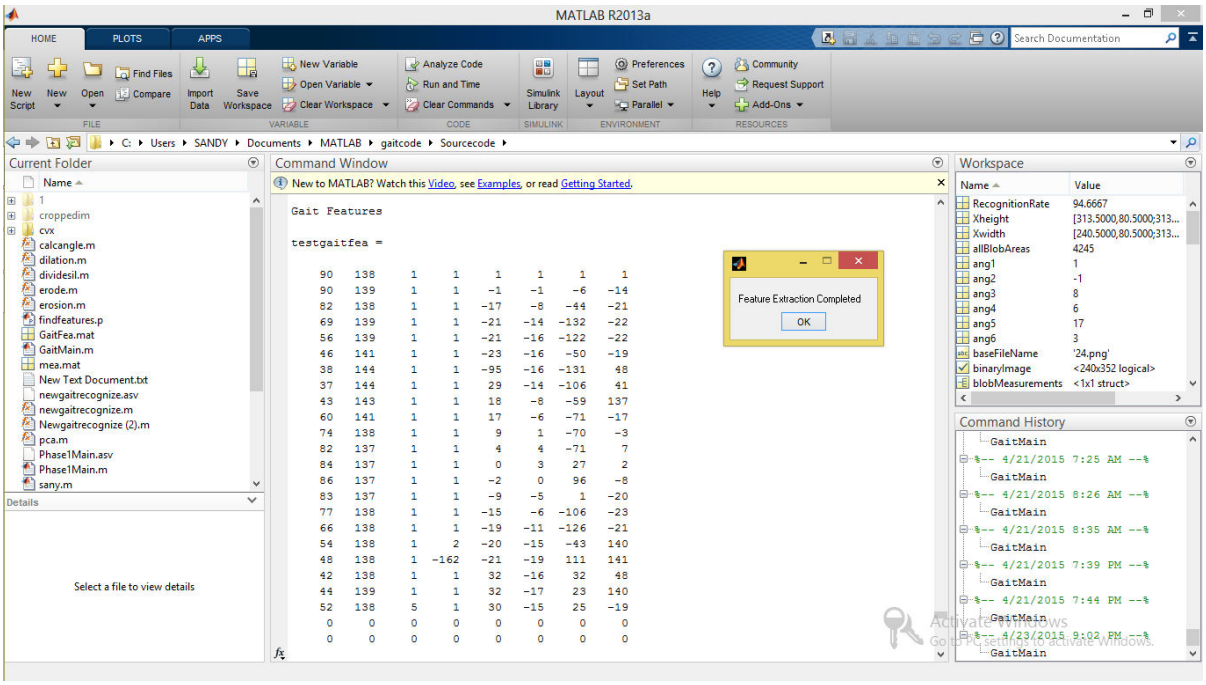

Figure 21: Gait Features

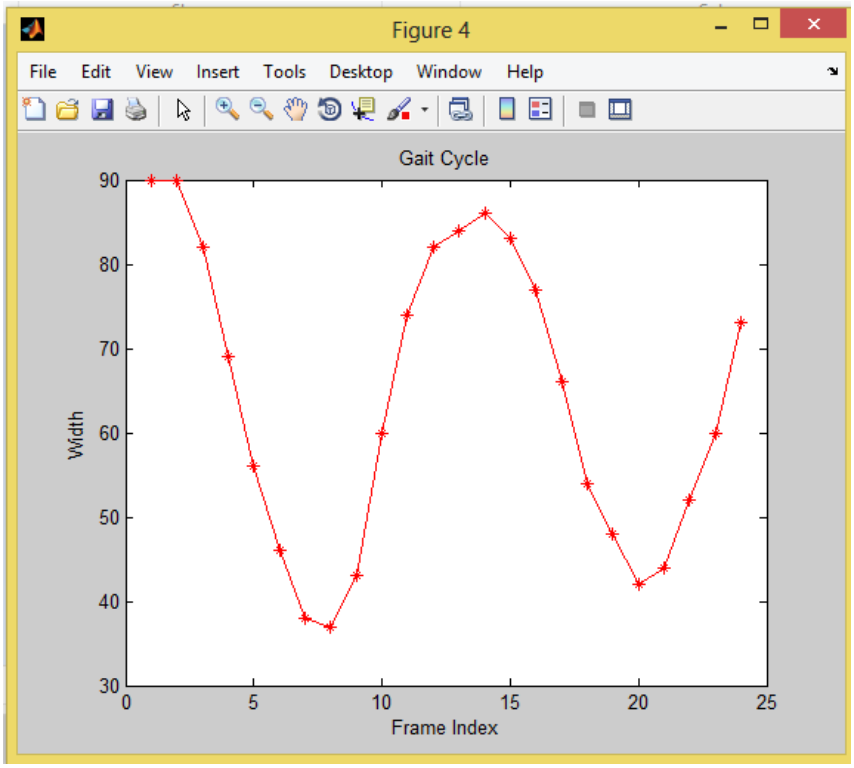

Figure 22: Gait cycle

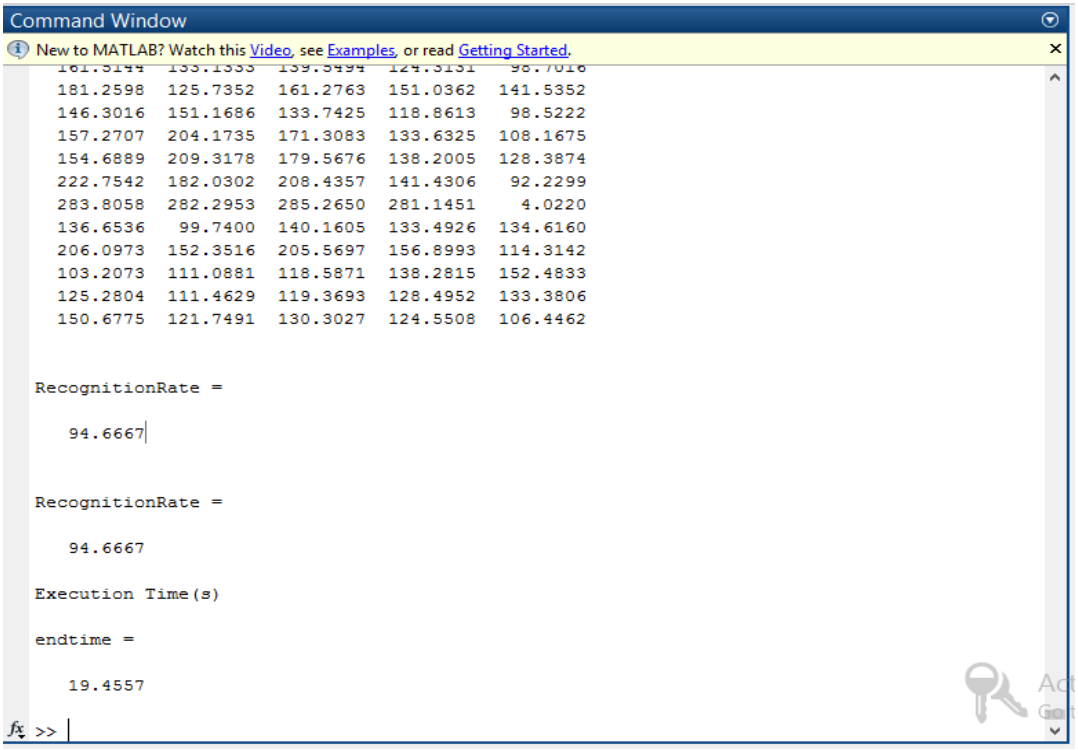

Figure 23: Recognition Rate and Time

4.3 Cross walking:

First we track the walking sequence of the person that is cross walking (figure 24). Next step was feature extraction in this based on waking sequence we find out the skeleton of persons silhouette (figure 25). Then we obtain the angles of the skeleton (figure 26), these feature vector values useful for efficient recognition. Based on these values we find the gait cycle of a walking sequence of a person (27). After that perform recognition based on the final feature values (figure 28).

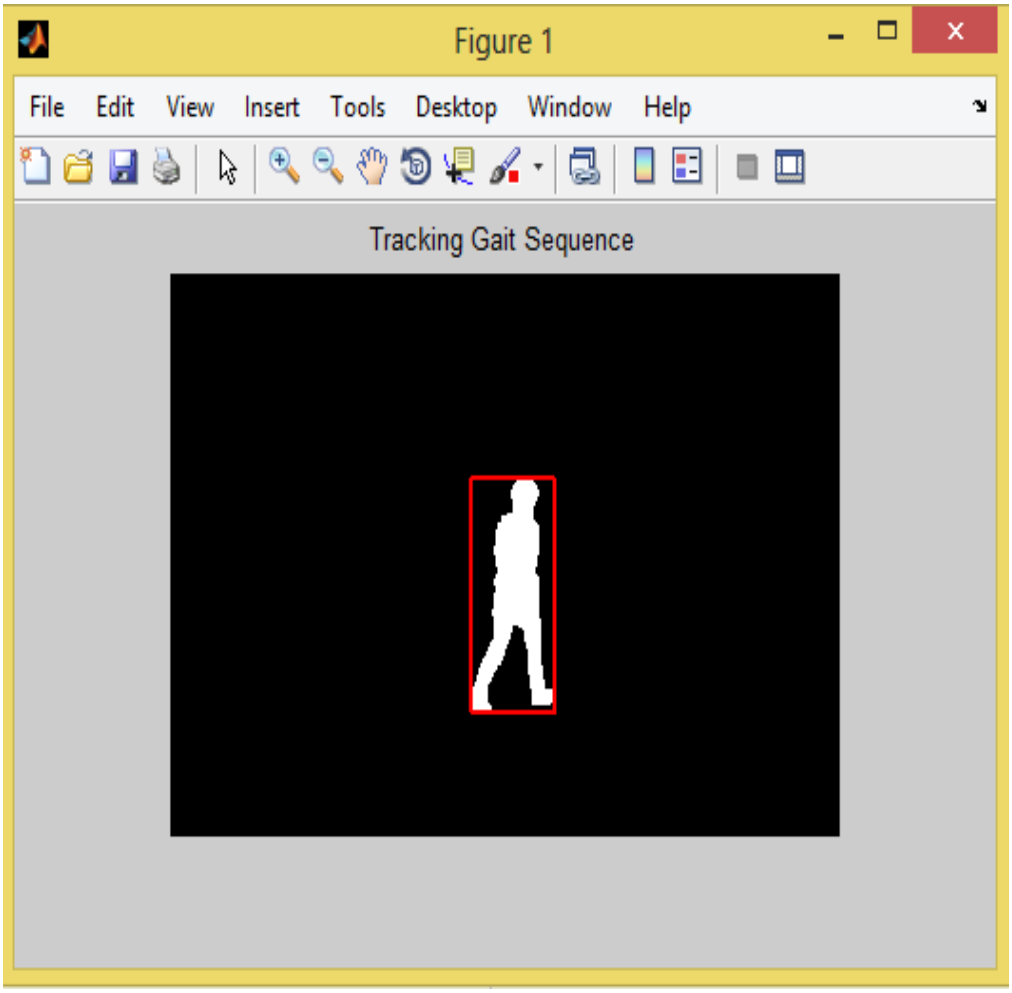

Figure 24: Tracking gait sequence (cross walking)

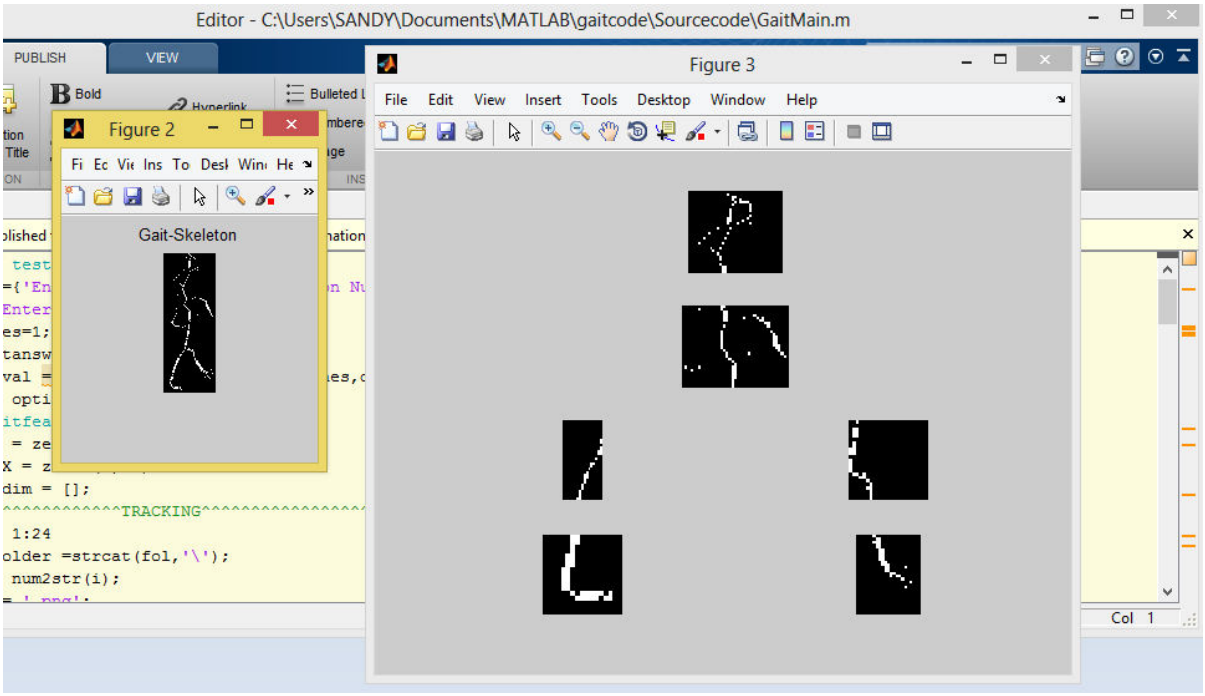

Figure 25: Gait skeleton and Angles

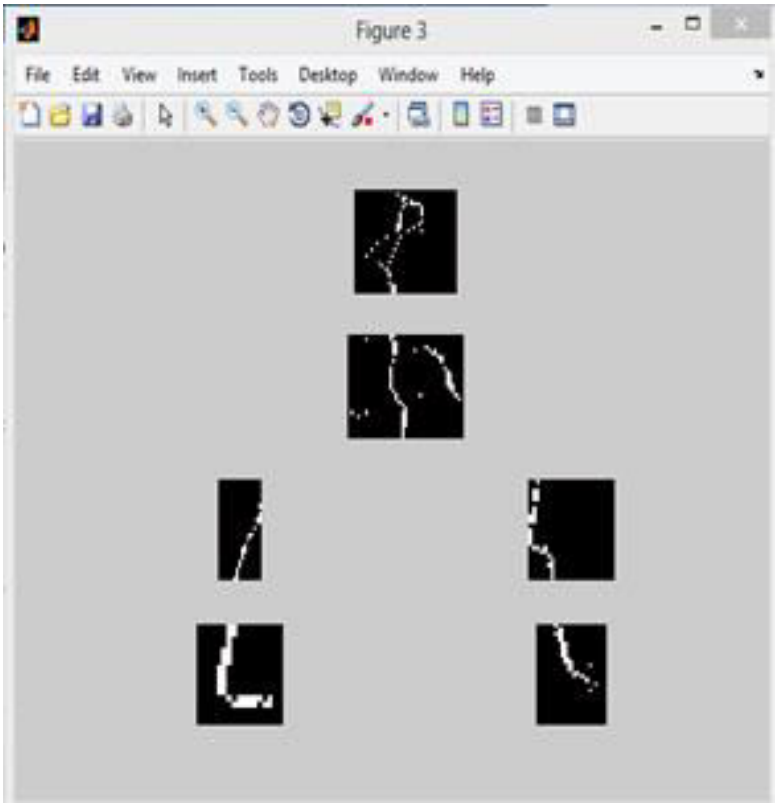

Figure 26: Gait Angles

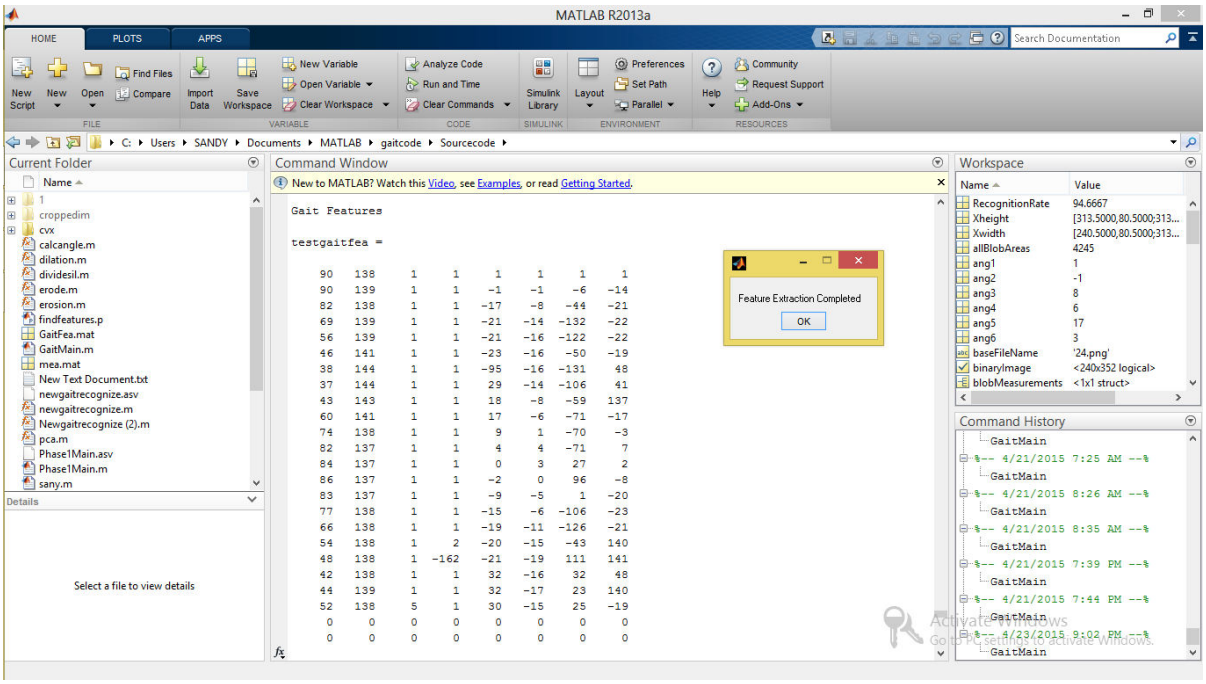

Figure 27: Gait Features

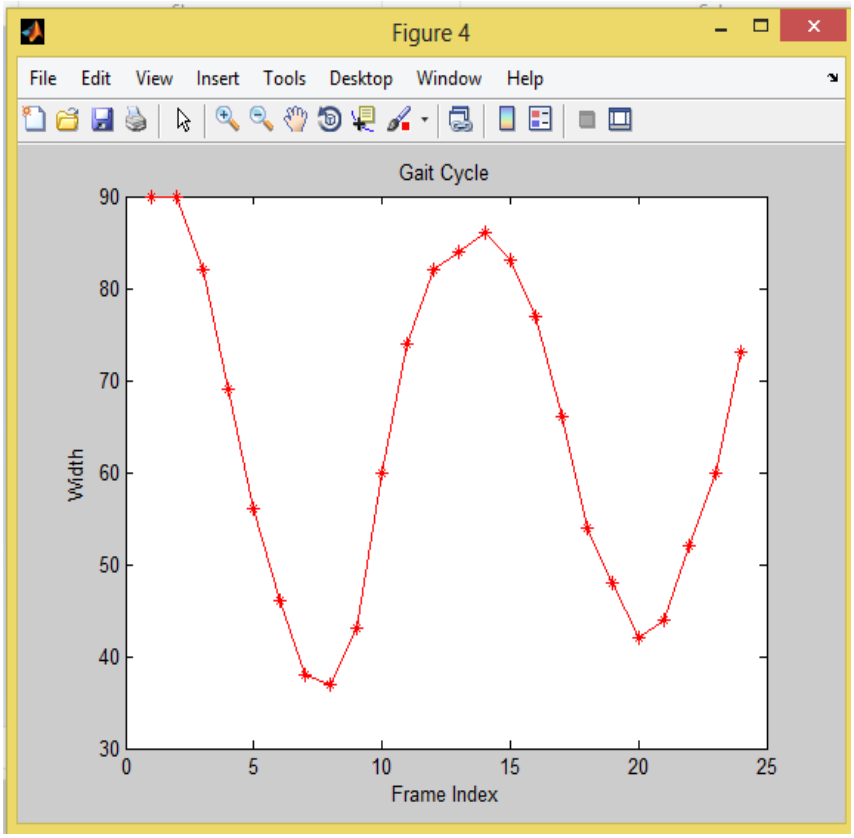

Figure 28: Gait Cycle

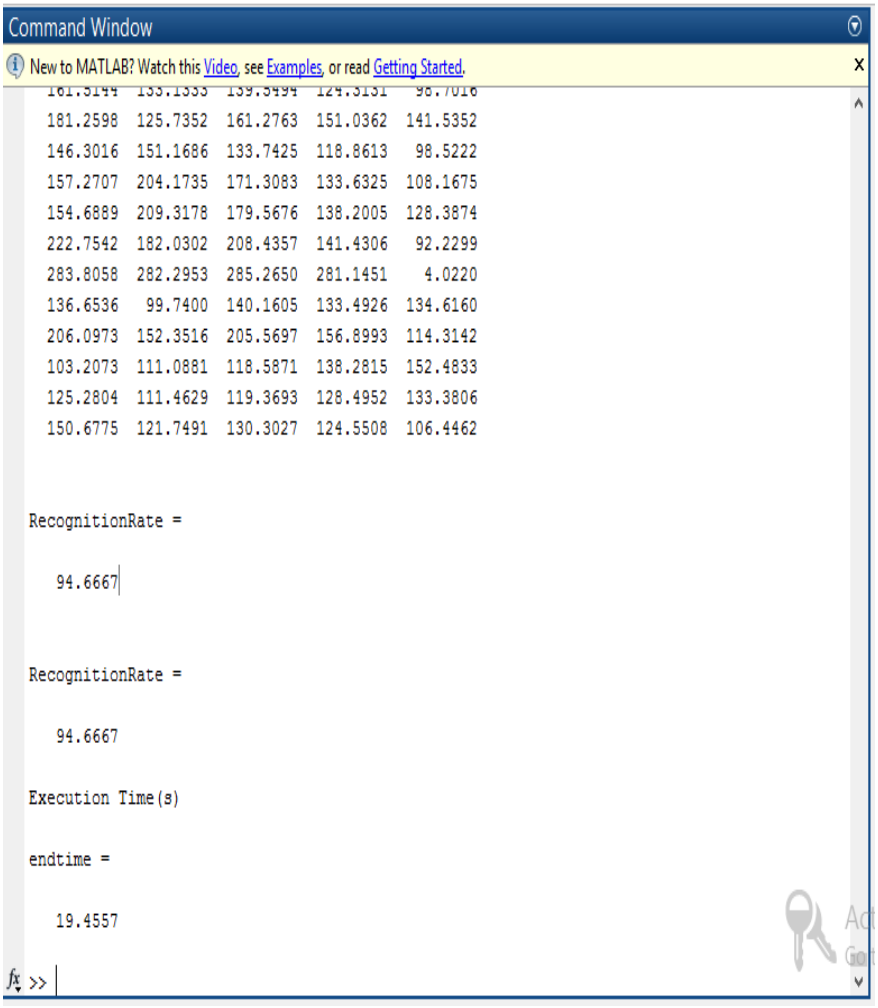

Figure 29: Recognition Rate and Time

The proposed method used the predefined background subtracted images that is walking from left to right, walking from right to left and cross walking. In the three walking cases it provided good results of recognition and time. We have also observed that the proposed algorithm also provides the efficient recognition. This proposed algorithm has applied on the predefined background subtracted images.

Table 1: Recognition Rate and Time (walking sequence)

WALKING SEQUENCE	RECOGNITION RATE	TIME
1.left to right	94%	17 min
2.right to left	95%	19 min
3. cross walking	94.6%	19 min

In the above table shows that proposed system provides efficient recognition over the different walking sequences (left to right, right to left, cross walking).

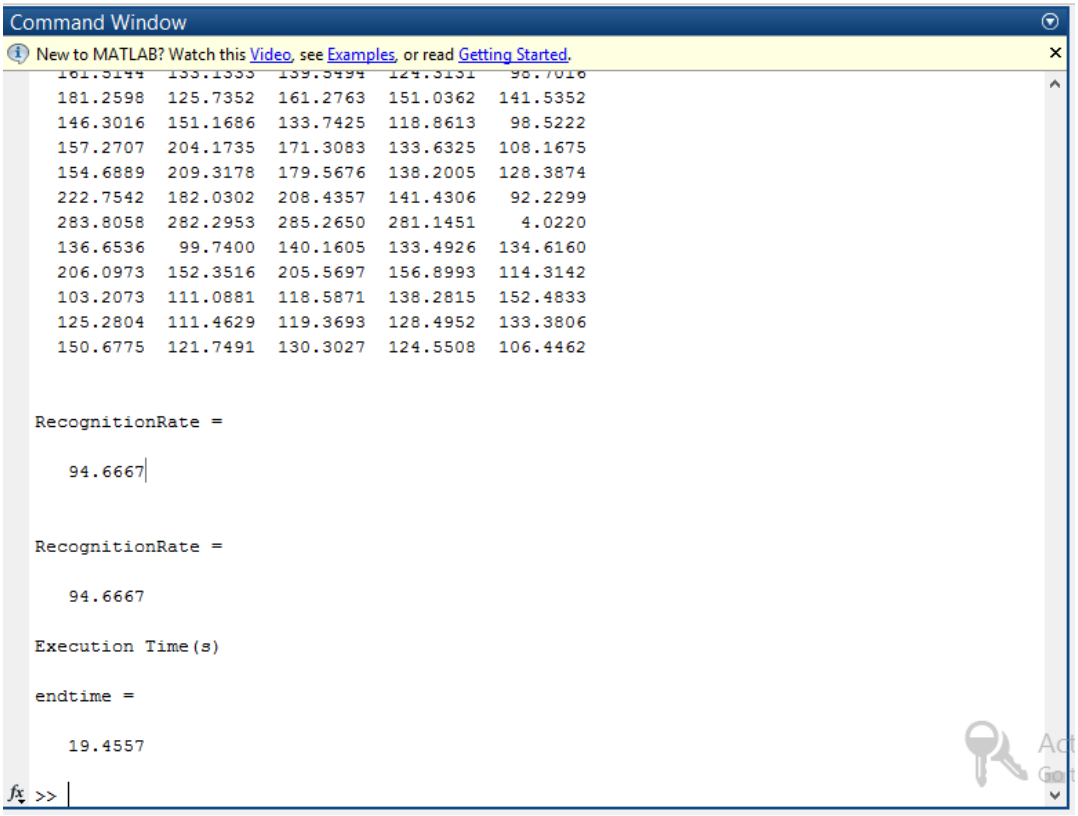

Figure 30: Recognition Rate

First we track the walking sequence of the person that is walking from right to left. Next step was feature extraction in this based on waking sequence we find out the skeleton of persons silhouette. Then we obtain the angles of the skeleton, these feature vector values useful for efficient recognition. Based on these values we find the gait cycle of a walking sequence of a person. After that perform recognition based on the final feature values.

CHAPTER 5

CONCLUSION ANF FUTURE SCOPE

Conclusion

The Advantages of proposed method are, it has provided efficient recognition and time of a walking sequence. When we have used predefined background subtracted images complexity became less. It provides efficient recognition against multiple views (walking from left to right, walking from right to left and cross walking). This proposal presents feature vectors that are height, width vectors and angles of a skeleton. We combine these two feature vectors for efficient classification and recognition purpose. Use the predefined background subtracted images that are generated by the Gaussian mixture model for extracting the foreground object. The second step is Feature extraction; in this we extract feature vectors of a skeleton. Third step is to reduce dimensionality of a feature vectors using PCA, so as to obtain the normalize feature vectors. Forth step is to make sure that MDA increases the separation between classes and reduces the inner class separation this process can be useful for reduce classification computation.

Future Scope

In this paper we used MDA for classification. In place of MDA if we will use combination of classification methods like SVM+BPNN may provide efficient classification rate. Performance rate has to be improved for occlusion, clothing style conditions and also for different walking considerations.

CHAPTER 6

REFERENCES

References

Reports and Official Documents

[1] Aly A. Farag Shireen Y. Elhabian CVIP Lab (2008), "*A Tutorial on Data Reduction*".

[2] Davrondzhon Gafurov Gjovik University (2007), "*A Survey of Biometric Gait Based Recognition Approaches, Security and Challenges*".

[3] Dong Xu, Shuicheng Yan, Dacheng Tao, Lei Zhang, Xuelong Li, and Hong-Jiang Zhang (2006),"*Human Gait Recognition with Matrix Representation*".

[4] D Sung-Jung Cho (2005), "*Introduction to Hidden Markov Model and Its Application*".

[5] K.B. Low, U.U. Sheikh (2013), "*Gait Recognition Using Local Ternary Pattern (LTP)".*

[6] Kenton R. Kaufman (2009), "*Future Directions in Gait Analysis*".

[7] Liang Wang, Tieniu Tan, Huazhong Ning, and Weiming Hu (2003),"*Silhouette Analysis-Based Gait Recognition for Human Identification".*

[8] Lili Liu, Yilong Yin, Wei Qin, Ying Li (2010),"*Gait Recognition Based on Outermost Contour".*

[9] Lindsay I Smith (2002), "*A Tutorial on Principal Components Analysis*".

[10] Mark S.Nixon, John N.carter,*"Automatic Recognition by Gait Progress and Prospects".*

[11] Mingyue Tan (2004), "*Support Vector Machine & Its Applications*".

[12] Nikolaos V. Boulgouris, Dimitrios Hatzinakos,and Konstantinos N.Plataniotis (2005), " *Gait Recognition A Challenging Signal Processing Technology for Biometric Identification*".

Websites:

http://www.biometricupdate.com/research

http://nptel.ac.in/courses.php?disciplineId=106

http://thegaitguys.tumblr.com/

CHAPTER 7

APPENDIX

7.1 Questionnaire

a. Why do we need Gait recognition?

In Gait recognition third part cooperation is not required. Provide high efficiency over long distance also. Now a day's thieves are so clever Any bank robbery they uses glosses and masks in that situation thumb and face iris recognitions fails. In this particular situation Gait recognition helps if any cctv cameras capture the image based on the walk sequence easily caught the thieves. This gait recognition used for Guard against terrorism and domestic crimes and Improve security in airport embassies and military. Gait recognition used in shopping malls and companies also. An innovative tunnel approach, in this record an individual gait and then criminals can be made to walk through these tunnels to record their data within the data bank for easy identification respect their crimes.

b. What is the problem in existing method?

In this existing system uses one feature vector of an outer most contour this not sufficient for all cases. Uses single view data base. This is not enough for efficient recognition. Performs feature extraction based on contour if persons image is very small in that situation it fails.

c. How proposed method works?

The proposed system provides high accuracy compared to the existing system. In this method use two feature values that is width vector and ART coefficients (shape information).It is useful for best recognition. Based on the values easily classify the data using MDA.

7.2 List of abbreviations

PCA-"principle component analysis"

MDA-"multiple discriminant analysis"

SVM-"support vector machine"

LDA-“linear discriminant analysis”

HMM-“hidden markov model”

CCR-“correct classification rate”

Publications

Paper accepted

I. Katakam Santosh and Chirag Sharma (2015)"A New Approach for Gait Recognition Using Width Vector, Angles and MDA", International Journal of Applied Engineering and Research (IJAER).