Biometrics for Persons Tracking
(Principles and Development)

تقنيات القياسات الحيوية لغرض تتبع الأشخاص (المبادئ و التطوير)

محمد عبد العزيز محمد

دبلوم عالي في تكنولوجيا المعلومات من معهد المعلوماتية للدراسات العليا

في الهيئة العراقية للحاسبات والمعلوماتية

Abstract

A large collection of different systems need to reliable and accurate tracking of persons in sequence of video to use in a variety of applications such understanding of human actions and interactions, the interaction between human and computer, monitoring and security, augmented reality, editing of video, control to traffic, the communication by video and medical imaging. but the old techniques are inadequate for such tracking; instead a young technology will be used it is biometrics technology. The goal of this search is to Proposed a biometrics video tracking system use multiple biometrics technology to reliable and accurate tracking for persons in sequence of video and will proposed new biometric for tracking person is skeleton. Also this search explains most related concepts to this goal. and introduces general view of use biometrics to persons tracking. where A person is one of objects of interest in video, but tracking persons is a critical task because actions by humans in real-world settings involve large changes in the person's pose and the relative orientation with respect to the camera and different appearances. Biometrics techniques in this concern will be discussed. it involves persons recognition automatically depend on their behavioral and biological traits. Biometrics like face recognition and gait can be used to detect and tracking human in a video sequence. where this process involves continual estimate of person(s) location by using a camera. This process called video tracking The heart of video tracking is video tracker which estimates the location of the object over time. As known, objects of interest in a video sequence may be persons or other objects. In order to recognize person's anatomical and behavioral traits for persons are used which make the video tracker recognize persons in more trust. but despite current development, and increase the progress in the future no system to now can strongly deal with the complexities of human pose and motion and human biometrics in an entirely general setting.

الخلاصة

مجموعة كبيرة من الأنظمة تتطلب تتبع دقيق و موثوق للأشخاص في مقطع فيديو لاستخدامه في تطبيقات متنوعة مثل تفاعل البشر و الكومبيوتر، الأمن و المراقبة ، اتصال و ضغط الفيديو ، الحقيقة المدموجة ، السيطرة على المرور ، تصوير وتحرير أفلام الفيديو الطبي و فهم أفعال و تفاعلات البشر. لكن التقنيات القديمة غير كافية لمثل هذا التتبع ،وبدلا من ذلك تقنية حديثة سوف تستخدم هي تقنية القياسات الحيوية.هدف هذا البحث هو اقتراح نضام تتبع معتمد على القياسات الحيوية و يستخدم تكنولوجيا القياسات الحيوية المتعددة لغرض التتبع الدقيق و الموثوق للأشخاص في مقطع فيديو كذلك سيقترح عامل قياس حيوي جديد لتتبع الأشخاص هو الهيكل العظمي ،أيضا هذا البحث يوضح معظم المفاهيم المتعلقة بهذا الهدف و يقدم نضرة عامة عن استخدام القياسات الحيوية في تتبع الأشخاص حيث الشخص هو واحد من الأهداف المتفاعلة في الفيديو لكن تتبع الأشخاص هي مهمة صعبة لأن أفعال البشر في البيئة الحقيقة تنطوي على تغييرات كبيرة في موقع الشخص واتجاهه بالنسبة للكاميرا والمظاهر المختلفة له. بهذا الشأن سوف تناقش تقنيات القياسات الحيوية وهذا يتضمن التمييز الآلي للأفراد بالاعتماد على خصائصهم السلوكية والبيولوجية. القياسات الحيوية مثل تمييز الوجه والمشية يمكن أن تستخدم لتحديد الشخص في مقطع الفيديو.علما أن العملية المتضمنة التخمين المستمر لموقع هدف أو أكثر باستخدام الكاميرا تسمى تتبع الفيديو. تتبع الفيديو هي عملية تحديد موقع هدف متحرك أو عدة أهداف بشكل مستمر باستخدام كاميرا. الأساس في عملية التتبع هو المتتبع الذي يخمن موقع الهدف مع الوقت،وكما هو معروف الأهداف المتفاعلة في مقطع الفيديو ربما تكون أشخاص أو أهداف أخرى، ولأجل تمييز الأشخاص نستخدم السمات التشريحية والسلوكية للأشخاص والتي تجعل متعقب الفيديو يحدد الأشخاص بثقة أكبر.لكن وبالرغم من التقدم الحاصل ، ووجود بوادر توحي بتقدم اكبر لكن لا يوجد نظام لحد الآن يستطيع التعامل بقوة مع كل التعقيدات المكتشفة لوقفة الإنسان وحركته و صفاته التشريحية في البيئة العامة بشكل كامل.

1.Introduction

A common problem is verifying that a person has the said identity to track or authentication or others[1]. This problem can solve effectively by use biometrics technology where the biometrics is the automated recognition of individuals based on their behavioral and biological characteristics[2].

In this days the machines that use in process of tracking which see and understand are available also the video analysis algorithms and micro-electronics are developed additionally appearance the young technology (Biometrics) all these make the tracking of the persons more easy. The term "persons tracking " refer to many meanings like tracking persons on mobile network ,internet network , tracking persons by authorization systems and so on ,Which intended in this search is tracking persons in video scene (video tracking) therefore will use a modern technology is a biometrics because the traditional technologies based on image processing not give the required accuracy like biometrics technology.

This search will be discuss video tracking concept for persons and its applications and types ,challenges of tracking , biometrics technology ,user interaction with it , a good biometrics features ,use biometrics for video tracking and the most biometrics technologies for video tracking, and propose new biometrics (skeleton) to use in video tracking and propose video tracking system with ability to detect and track persons like human ability where the accuracy is high.

2. Video tracking

In general the process of estimating over time the location of one or more objects using a camera is referred to as video tracking[1]. Video tracking can be a time consuming process due to the amount of data that is contained in video. Adding further to the complexity is the possible need to use object recognition techniques for tracking [3]. Object recognition – in computer vision, this is the task of finding a given object in an image or video sequence [4]. The definition of object of interest depends on the specific application at hand[1]. with respect to persons actions in real-world settings involve large changes in the person's pose and the relative orientation with respect to the camera [5].Both detection and tracking people are challenging problems, especially in complex real world scenes that commonly involve multiple people, complicated occlusions, and cluttered or even moving backgrounds[6].

The uses of the result of video tracking process is wide where large number of applications use these results like surveillance applications, applications of traffic control, video editing applications, medical imaging applications and so on. particularly when the object of interest in the video is a human will be there many challenges(discussed below) that must be processed. The type of application will select the type of object that must be recognize to be tracking for example: In interactive gaming the objects are faces (Figure1 (right)) while in applications of monitoring the objects are people(Figure1 (left)).

Figure(1). Examples of object for video tracking: (left) people, (right) faces[1].

When we want to design system of tracking we must attempt to make system ability like human ability to detect persons, Human can recognize many persons in video scene easily, in spite of persons have different images in same video because they have different sizes, also when they are move or turn around ,or even when they are partially covered by another objects. all these abilities will be challenges when we design system of tracking .

3.Types of the tracking

Depend on quantity of users interaction to recognition the object(s) of interest like face or gait or other. Algorithms used in video tracking can be classified in to three kinds: manual , interactive (or superintended) and automated (unsuperintended):

3.1 Tracking by user

When we need high accuracy in tracking we must performed tracking by user directly, example of this when we define objects boundaries using tracking by user is necessary. film production is one of most application requires manual tracking[1]. the advantage of this tracking is give accurate definition to the object location (or its edges) but it has disadvantage where consume long time relatively and when there is large amount of visual data cannot be used extensively.

3.2 Automated tracking

In this type of the tracking the algorithm involve necessary information relate to the objects. example of this applications based on detection of face or iris. The techniques of automated tracking are in their infancy to now. Because the process of translating the attributes of a generic object into algorithmic standards is a hard task in the scenes that non-constrained[1].the advantage of this tracking is consume short time relatively, but it has disadvantage where it less accurate from manual tracking when compare with manual tracking.

3.3 Interactive (semi-automated) tracking

This type of the tracking is a trade-off case between automated tracking and a manual tracking. where the basis is the user involve during process of the tracking sometimes. where the user provide information about the object area directly. This type of the tracking used in applications like surveillance and video editing. the tracking algorithm performed the tracking after an operator detect object of interest manually. The tracking phase can be unsupervised ,or the operator can continues to supervise the tracking to correct result if require. example for this in surveillance application first the operator detect the person then followed by camera automatically [1]. this type of tracking will collect the advantages of manual and Automated tracking where will give accurate result and quickly and it will reduce the disadvantages of previous types of tracking.

4. Applications of video tracking

The many of various applications require tracking of objects in video. This applications like interactive games , robotics , surveillance and other. Video tracker used to make understand huge video data better ,by decreasing the quantity of manual labor that is required to achieve a task . and to improve interaction with machines naturally.

they can be classified in six main groups:
1.Interactive gaming and Tele-collaboration.
2. The Surveillance applications for security.
3.Biological and Medical research.
4.Unmanned vehicles and the Robotics.
5.Augmented reality and Media production.
6.The performance and installations for Art[1].
Each one of these applications require particular tracking results such as monitoring applications require tracking the human body while the games applications require tracking human face or hands and so on. for this reason will use specific biometric which give the required results.

5. Challenges of tracking

The main challenges that have to be taken into account when designing and operating a tracker are related to the similarity of appearance between the target and other objects in the scene , and to appearance variations of the target itself[1].These two major challenges must be keep in mind during designing the tracking system and when operating it, And must take in account that in the real environments there are many changes in persons orientation and pose in respect of the camera this also important challenges. Also when use biometrics in video tracking must process the restraints such as disability to information extract .

Figure(2). Provide a summary of challenges of video tracking .These challenges lead to differences of the target appearance itself and similarity with other objects appearance:
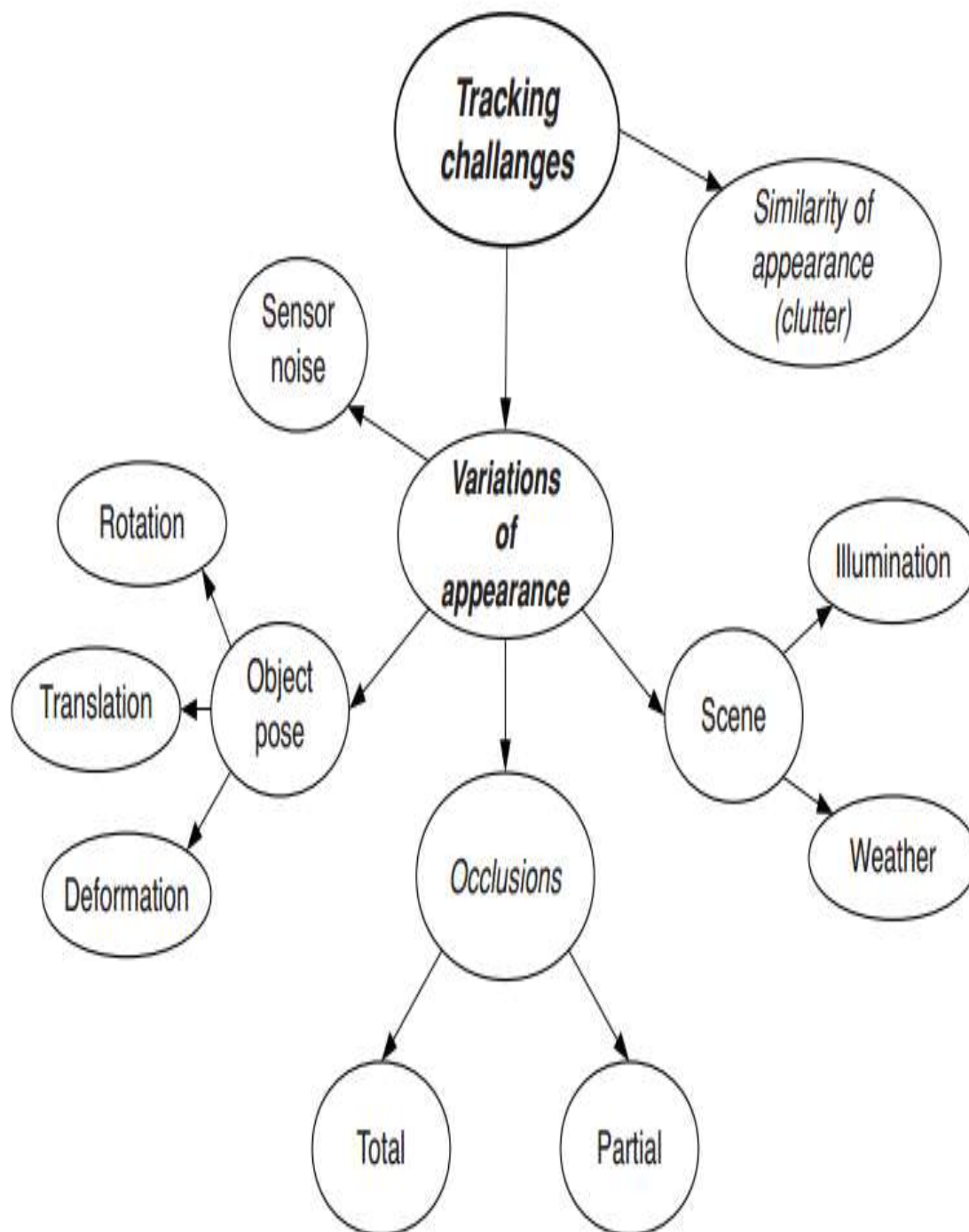
Figure(2). The main challenges in video tracking[1].

A- Similarity of appearance(clutter)   : The appearance of other objects and of the background may be similar to the appearance of the target and therefore may interfere with its observation this phenomenon called clutter [1]. Can process clutter by using biometrics traits which define each person uniquely.

Figure(3). Example of clutter in video tracking[1].

B- Variations of appearance : This variations comes from :

1- **Changes in pose :** A moving target varies its appearance when projected onto the image plane, for example when rotating (Figure 4(a)(b))[1]. The full biometric model can be used to addressed this challenge where the information about the biometric feature obtain from all view angles around the person.

(a)   (b)

Figure(4). Examples of target appearance changes that make video tracking difficult[1].

2- **Ambient illumination :** The direction, intensity and color of the ambient light influence the appearance of the target. Moreover, changes in global illumination are often a challenge in outdoor scenes[1]. some biometrics don't affected by ambient light because they are clear and cannot covered such as gait , like this biometrics used to process the ambient light.

3- **Noise :** The image acquisition process introduces into the image signal certain degree of noise, which depends on the quality of the sensor[1]. This can be processed by high quality sensor.

4- **Occlusions :** A target may fail to be observed when partially or totally occluded by other objects in the scene.
Occlusions are usually due to:
1 -a target moving behind a static object, such as a column, a wall, or a desk(Figure 5(a)).
2 -other moving objects obscuring the view of a target (Figure 5(b))[1].

the human body is different of anything in environment even when appear part of this body we can recognize it therefore using biometrics will pass this challenge.

<div align="center">(a)   (b)</div>

Figure(5). Two examples of target occlusions[1].
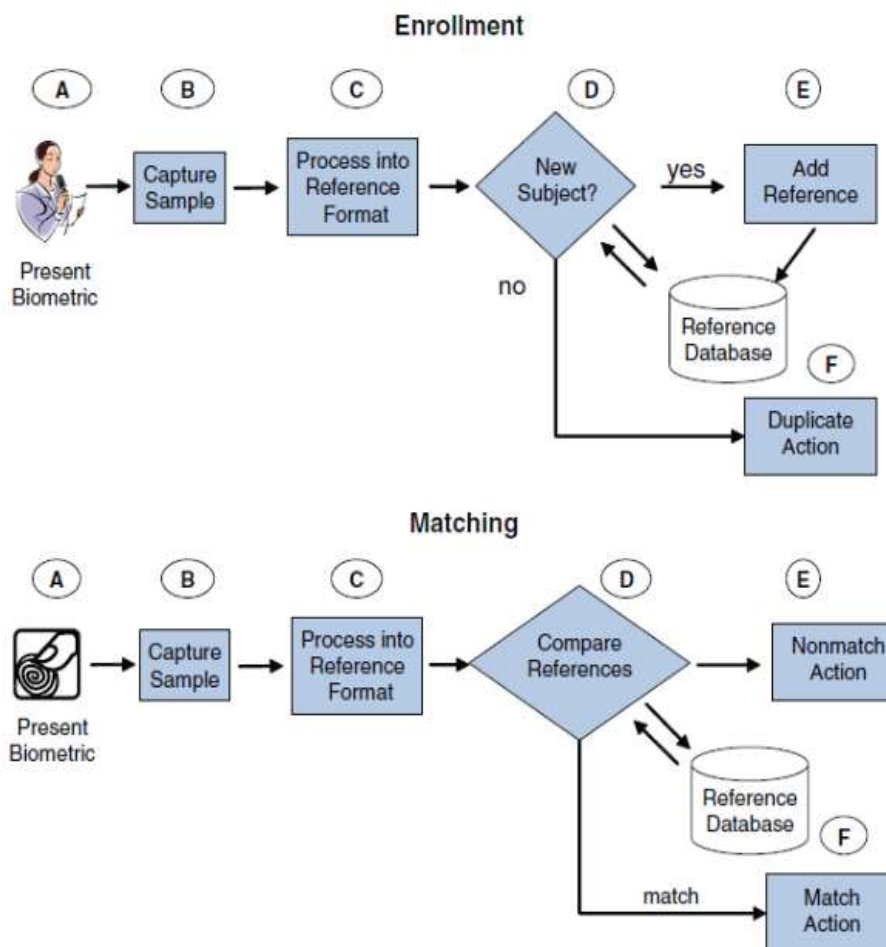
6. Biometrics technology

Biometrics is the automated recognition of individuals based on their behavioral and biological characteristics[2].In general Biometric recognition can be used to establishing the identity of A person or detection A person using his/her anatomical and behavioral traits (fingerprint ,face , iris , hand geometry, voice, palm print , handwrite signatures, gait) [7]. biometric features have been widely used in many applications because they possess the following physiological properties : universality, uniqueness, permanence, collectability, performance, acceptability, and circumvention one of these systems is person detection and tracking system[8]. Also tracking of persons in real-world environments and in real-time is a common goal in many video applications [9]. biometric is a physical or psychological trait that can be measured, recorded, and quantified. By doing this, we can use that trait to obtain a biometric enrollment[10].The video tracking become more easy by use biometrics. Use biometrics in video tracking make this task easier and more accurate because each person has many biometrics traits and each trait have properties like: uniqueness, collectability, universality, ,permanence, circumvention and acceptability, These properties are reason to use biometrics in many systems one of these systems is video tracking system .

7. Enrollment, Template, Algorithm, and Verification

In a biometric system, a physical trait needs to be recorded. The recording is referred to as an enrollment. This enrollment is based on the creation of a template. A template is the digital representation of a physical trait. The template is normally a long string of alphanumeric characters that describe, based on a biometric algorithm, characteristics or features of the physical trait. The biometric algorithm can be viewed as the recipe for turning raw ingredients—like a physical trait—into a digital representation in the form of a template. The algorithm will also allow the matching of an enrolled template with a new template just created for verifying an identity, called a live template. When a stored template and a live template are compared, the system calculates how closely they match. If the match is close enough, a person will be verified. If the match is not close enough, a person will not be verified [10].When treat with video tracking the process of recorded (enrollment) and process of creation the digital representation of a physical trait (template) must be accurate and exactly because any not accurate recorded or any error in a template will lead to error system results specially because we not use direct biometrics like fingerprint but use biometrics for different distance like face or gait.
The figure(7). Explain the recorded process and matching process.

Figure(6) Idealized operations of a generic biometrics system[2]

8.The interaction between user and biometrics technologies
Biometrics technologies can be classified based on the degree of user involvement that required to measure the feature biometrically. This involvement can be divided in two types:

8.1 Passive biometrics
The user not yield actively to the measurement. Where the user not aware there is system to measure his/her traits biometrically. These systems usually used in a surveillance application. also the passive biometrics suitable for detection more than authentication systems. The environment has effect to these systems, the examples are:
- Gait.
- Voice.
- Face[13].

These biometrics suitable for far distance relatively .

8.2 Active biometrics
The user yield actively to the measurement. Where the user aware there is system to measure his/her traits biometrically. These systems usually used in the authentication applications. The environment hasn't effect to these systems. The examples are:
- Fingerprint.
- Hand geometry.
- Retinal scanning.
- Iris scanning[13].

These biometrics not suitable for far distance relatively where use directly .

9. A good biometrics technology

A well biometrics technology has some properties :

A.   **User acceptance**
B.   **Ease of use**
C.   **Costs of technology**
D.   **Deploy ability**
E.   **Maturity of the technology**
F.   **Time for user habituated[10].**

User acceptance refer to the success of the biometrics technology where the acceptance measured by quantifiable means . These means such as calls to help desk, attempted authentication and times authentication or identification mechanisms are used. Ease of use refer to the success of technology based on its easiness in the case of use. Consumers not buy a technology that it's use difficult. In respect of biometric technology there are two issues must be used in easiness :Ergonomics and Biometric software.

If the cost of the technology is high , it will not deployed even if it is easy to use. The biometric technology costs involve :Costs of device , Costs of deployment and support. also the biometrics technology must be affordable and the user accepted it, to be able to deploy. the ability to deploy determined by: Size of devices ,Conditions of environment ,Requirements of infrastructure, Requirements of client/server system and Software   and hardware selection that support to methodology of deployment.

Also the biometrics must be available in markets before selecting. The technology more tested in the market is more mature and is the best technology to be used. Also must improve the generations of technology. The improvements to cost or size of device ,improvement to ergonomics or methods of measuring trait. And finally for success of the biometric system must taken in account the required time to user habituated. When user habituated to the technology the productivity and level of comfort will be increased. User habituated depend on choosing a biometric device .

Biometric systems that are ergonomic, simple to use, and mature tend to prompt the users to become habituated more fast than ones that are uneasy, difficult to use and immature. Certain features of different biometric devices can help in this. For example, a fingerprint scanner with a large surface area will allow a user to get ordinary to using it sooner than one with a smaller imaging area. A face biometric system that does not need the user to take a seat as still as another will permit the user to get used to it faster.

A good biometric, then, will have features and ergonomics that will help the user in becoming habituated.

10.Some biometrics for video tracking:
The most Biometrics Technologies for Video Tracking are:

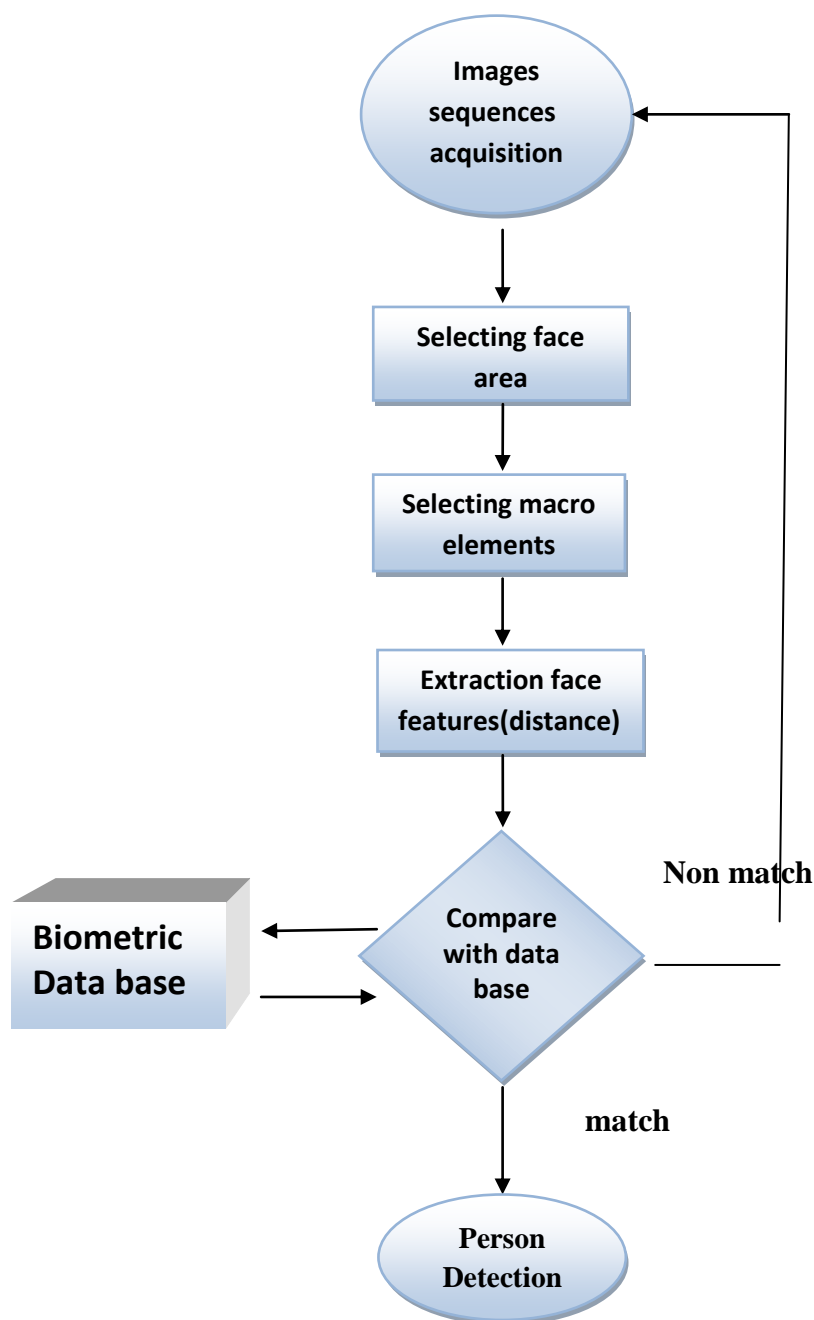## 10.1 Face biometric technologies:
Face biometrics are used by everyone every day. The face is the first defining characteristic that we use to identify someone. It is the face that is recalled when trying to remember what someone looks like. We use it, and eventually come to depend on it, for recognition. The face is made up of number of distinct macro and micro elements. elements like ears, forehead , lips, chin, cheekbones, eyes, nose and mouth consider macro elements. Other features like space between the macro elements, the feature's size and feature's reference. Also unseen to the human eye is the fact that our bodies and faces radiate heat, Which can be measured by using infrared cameras. All these feature scan be used by face biometric systems to help identify and detection someone [7]. Using face to detect persons is suitable for short distance applications where the face properties can seen. it is not suitable for far distance application but can use other biometric like gait. and we will adopt

compute the distance between macro elements like ears, forehead , lips, chin, cheekbones, eyes, nose and mouth to face recognition.
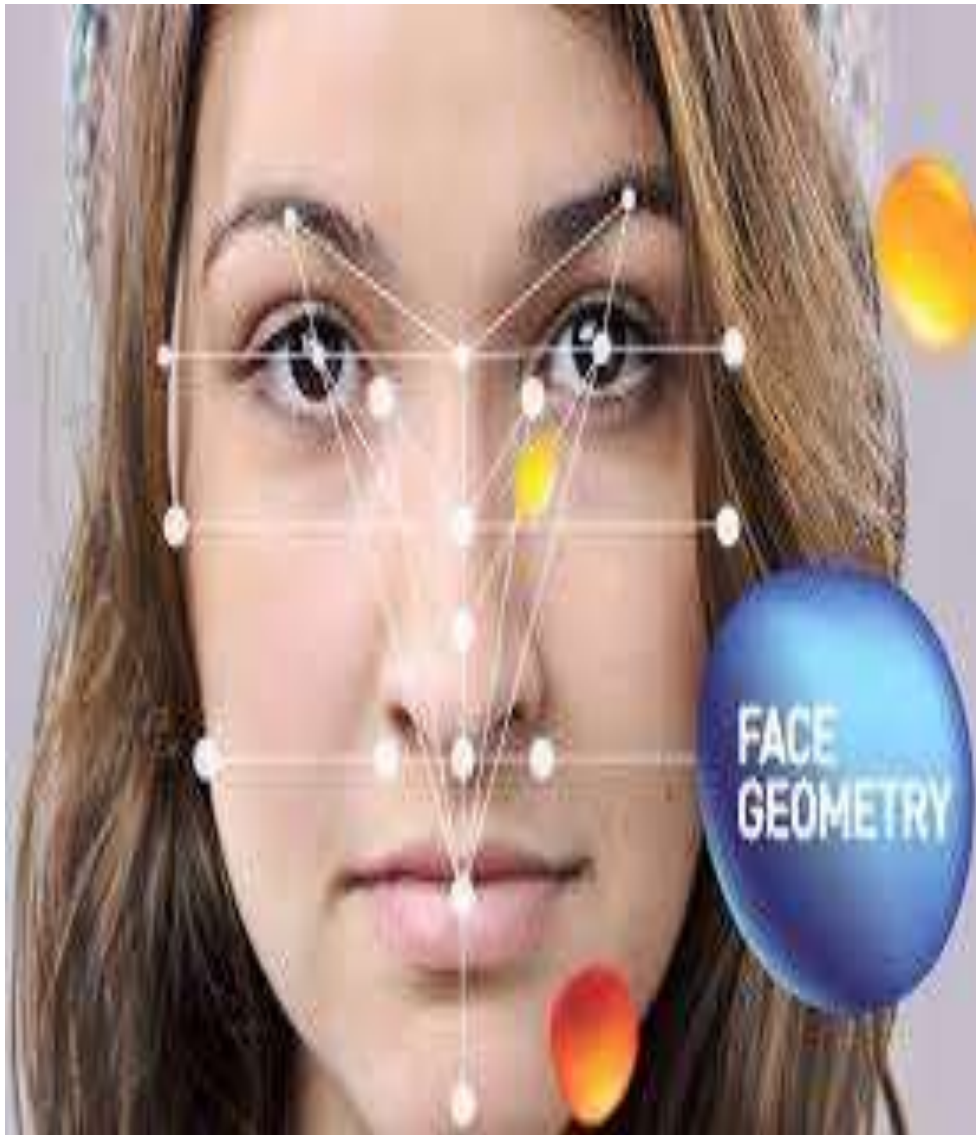
Figure(7).face biometrics[6].

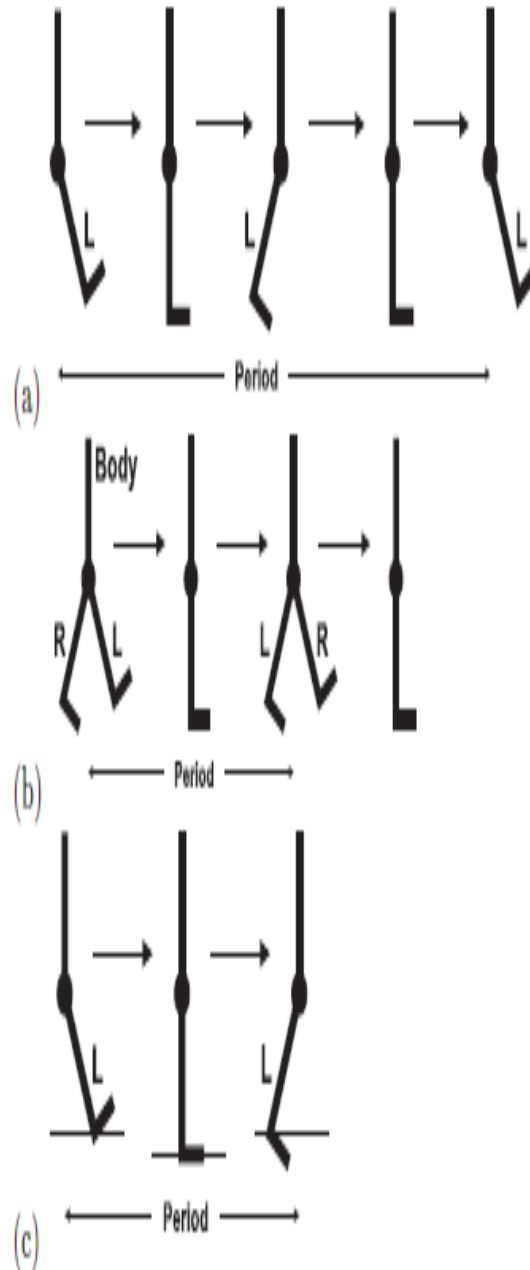proposed algorithm to using face to person detection :

```
        ┌─────────────┐
        │   Images    │
        │  sequences  │◄──────────────┐
        │ acquisition │               │
        └──────┬──────┘               │
               │                      │
        ┌──────▼──────┐               │
        │Selecting face│              │
        │    area     │               │
        └──────┬──────┘               │
               │                      │
        ┌──────▼──────┐               │
        │Selecting macro│             │
        │  elements   │               │
        └──────┬──────┘               │
               │                      │
        ┌──────▼──────┐               │
        │Extraction face│             │
        │features(distance)│          │
        └──────┬──────┘               │
               │                      │
               ▼            Non match │
        ◄──┐ ◇ Compare ┐──────────────┘
Biometric  │ with data │
Data base  └─ base ────┘
               │
               │ match
        ┌──────▼──────┐
        │   Person    │
        │  Detection  │
        └─────────────┘
```

Figure(8). Face algorithm[searcher].

10.2 Gait biometric technologies:

The person way to walk can be used to recognizing the person from afar distance relatively. The designers wanted to make the biometrics system simulate the human ability in recognition of gait This leads to create a new form of biometric characteristic (gait) can be used as a biometric identification. When compared the gait technology with other technologies such as face , voice. the gait consider young technology [11]. Human gait which is a fresh biometric technology used individuals way to walk to recognize them. It is have an significant role in surveillance applications. The motivation of using the gait is the need to system can recognize persons automatically to use in monitoring and surveillance applications[12].

Most of algorithms of gait analysis based on appearance-based methods which don't use the 3 dimensions nature of the movement [13]. The main advantage of using gait as a biometric is recognize persons from far distance relatively where cannot use other biometrics[14]. Human can recognize friends by recognize their gait where using gait as identifier from far distance relatively better than other biometrics identifiers such as face [15].

Also one of the most important uses of the gait is persons detection which can be used in a new systems for healthcare [16]. The gait is one of the most distinct marks of humans especial from afar distance for this using the gait will give great benefit when we need detect someone specially from far distance. and we will adopt find the speed of legs move (The frequency).

Figure(9).Stylized body and legs showing sources of different frequencies[13].

Proposed algorithm to using the gait to person detection :
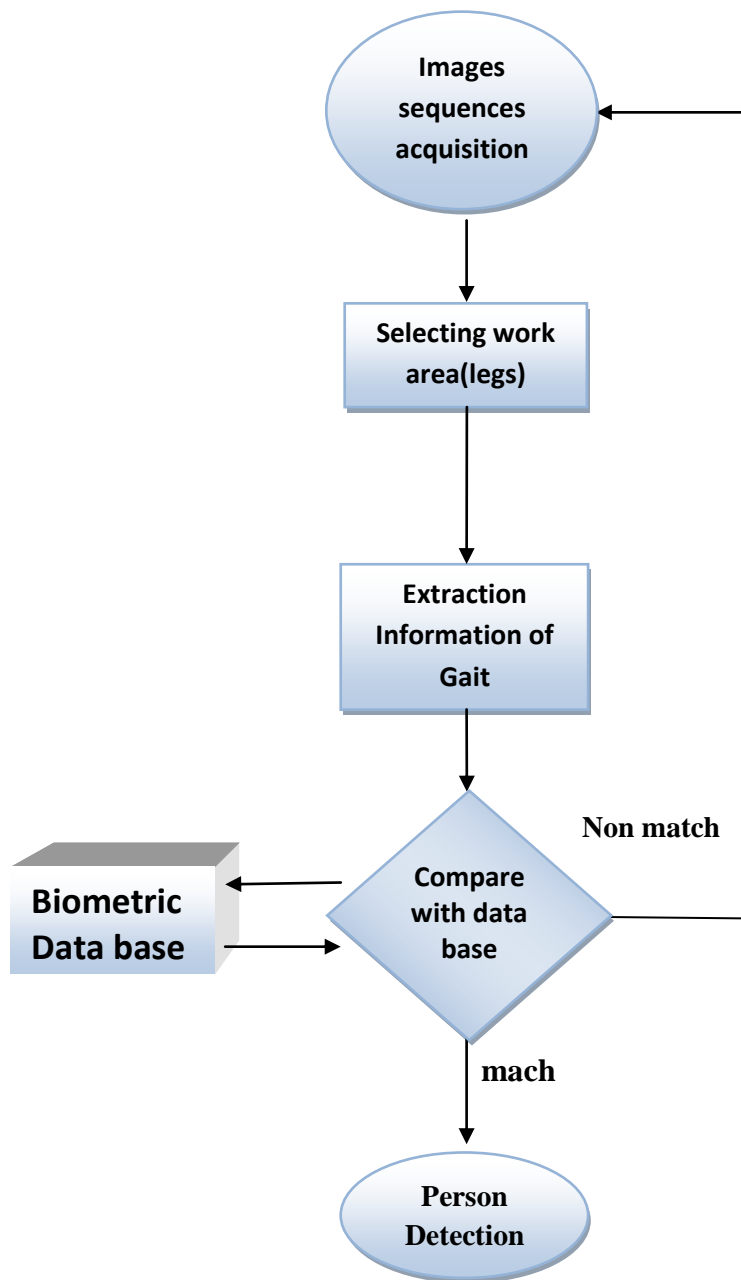
Figure(10). Gait algorithm [searcher]

10.3 The proposed new biometric to use in video tracking(skeleton):

The biometric technology like skeleton cannot be changed to deception the tracking system this is important advantage to this biometric. This biometric is not visible to eyes therefore must using infrared camera. The skeleton is made up of number of macro and micro bones and joints. each one have especial properties like length , shape and the distance between the joints and so on. our approach based on measuring the distance between the joints which differ from one to one. The new trend is developing biometrics systems that use two or more traits in integrated form. The term "Multiple biometrics" is intended to use two or more types of biometrics for this when using this technology with gait and face according to multiple biometrics concept will produce high accuracy tracking.

proposed algorithm to compute the distance between skeleton joints:
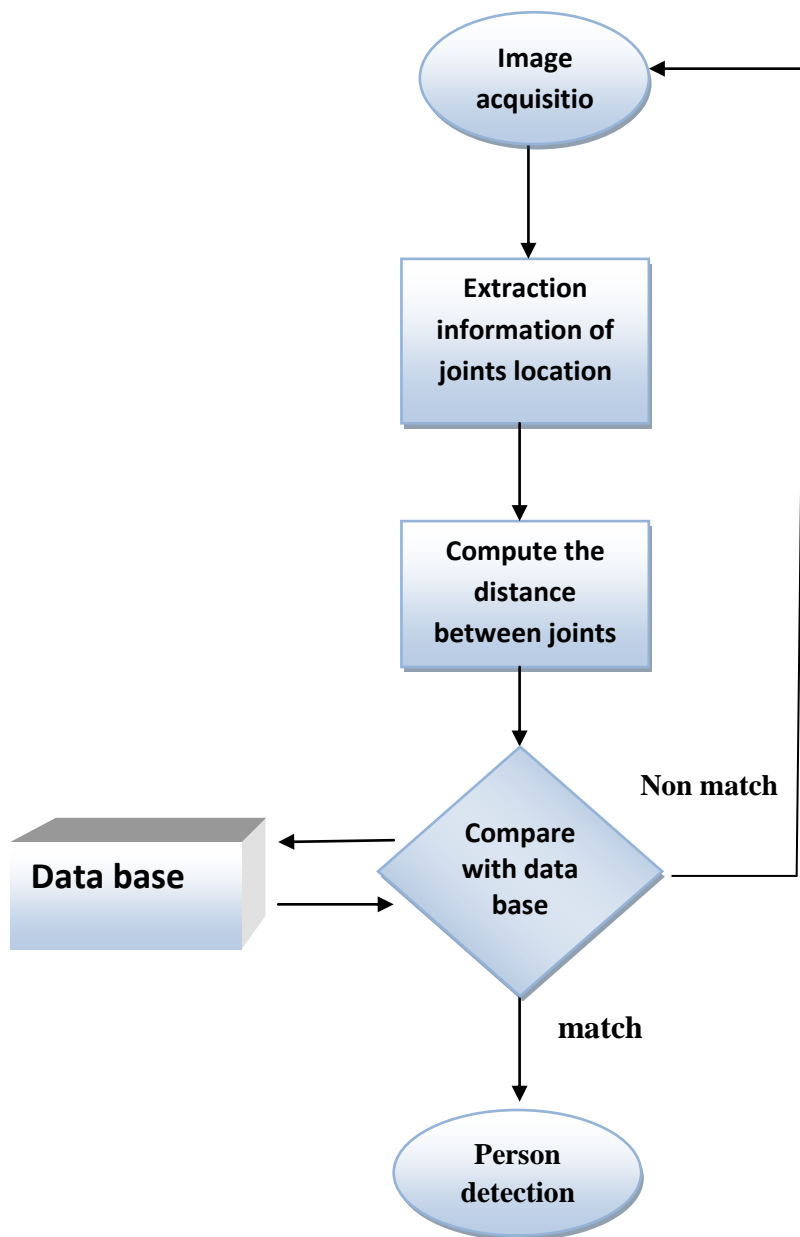
Figure(11). Skeleton algorithm [searcher].

11.The proposed biometrics video tracking system

The goal is propose video tracking system with ability to detect and track persons like human ability where the accuracy is high. The individuals have ability to recognize other individuals from far distance relatively by recognizing their gait and when can see their faces will recognize them exactly. In general biometrics can be used in video tracking system and using biometrics in video tracking increasing accuracy of result especially when use multiple biometrics this means using more than one biometric feature and using more than one instance to each feature. This system will use two biometric features (gait and face) to give result exactly to use in specific applications such as surveillance application.

This system consist of five main logical components (shown in Figure(8)) perform the detect and the tracking and process the challenges of the tracking(discussed above):

1- Video sequence acquisition: this component accept video sequences from number of cameras which used by system continually and send it to the second part.
2- Analysis video sequence: This component analyses the video sequence to obtain the area occupied by persons and skip unimportant area then send this to features extraction component.
3-Biometrics feature extraction: This component extracting biometric feature   information(A template) which it is gait and face and skeleton information. then perform comparison between the new template and database templates if there is matching the system will select the person as target. for this component connected with biometrics database which store templates to comparison.
4- Localization and target management :This component responsible for determination a target location continually and the targets management, the target management means how deal with disappearing and appearing targets from the scene.
5- Output video sequence(tracking persons):This part responsible for given the final result to the application that utilize tracking. This part in touch with application which use this system.
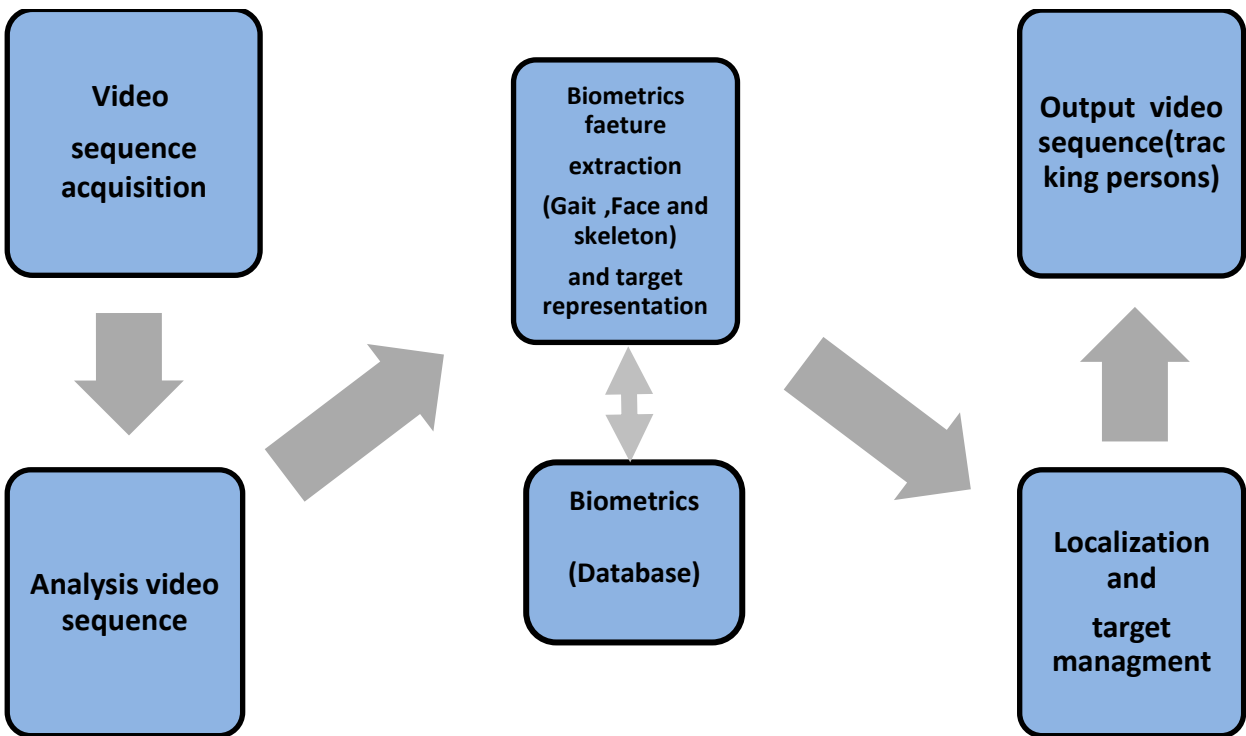
Figure(12). Main logical parts in video tracking system[searcher].

12. Conclusions

The process of continual estimate of person or persons location by using a camera is called video tracking ,The video tracking outputs required in various applications, use the traditional technique for video tracking may not give accurate result therefore will be using modern technology is biometrics technology. Use biometrics to persons tracking make this task easier and more accurate. Biometrics can be defined as physical / behavioral traits that can be measured to use in detecting and tracking individuals. There are two major challenges must be keep in mind during designing the tracker and when operating it the first is appearance similarity with other targets in the video scene and second is variety of appearance of object itself. The most biometrics technologies for video tracking are face and gait where the face is made up of number of distinct

macro and micro elements. And the main advantage of using gait as a biometric is recognize persons from far distance relatively where cannot use other biometrics. The biometric technology like skeleton cannot be changed to deception the tracking system this is important advantage to this biometric.

13. Suggestions for Future Works

1. Develop new biometrics like temperature of human.
2. Design a biometric system that uses a laser range scanner and a single camera to detect and track people for monitoring application.
3. Design a computational system for the real-time tracking of multiple persons in natural environments depends on biometrics.
4. Develop biometric system to diseases diagnosis biometrically.
5. Deploy sensor networks to track persons by their biometrics. Sensor networks are considered now to be an important area within the technology of networking. It could include hundreds of inexpensive nodes, each having communication and computational power.
6. Deploy artificial intelligent in person detection and tracking systems by develop the ability to recognize person in the complex senses.
7. Develop system to radio diagnosis biometrically.

References

[1] EMILIO MAGGIO | ANDREA CAVALLARO, "VIDEO TRACKING " , John Wiley & Sons Ltd, This edition first published 2011.
[2] Joseph N. Pato and Lynette I. Millett," Biometric Recognition ", THE NATIONAL ACADEMIES PRESS, Copyright 2010.
[3] "Video tracking " available at: "//http://en.wikipedia.org/ Video tracking" 2013.
[4] "Outline of object recognition" available at: "//http://en.wikipedia.org/ Outline of object recognition " 2013.
[5] PradeepNatarajan, Prithviraj Banerjee , Ram Nevatia ," Accurate Person Tracking Through Changing Poses for Multi-view Action Recognition" 2010.
[6]MykhayloAndriluka, Stefan Roth ,BerntSchiele" People-Tracking-by-Detection and People-Detection-by-Tracking"2008.
[7]shrutichanana, md.tabreznafiz ,Mustafa kamilmahdi and isha Sharma," Biometric Authentication And its Development "Excel India Publishers New Delhi 2012.
[8] Chin-Chuan Han, Hsu-Liang Cheng, Chih-Lung Lin, Kuo-Chin Fan," Personal authentication using palm-print features", Received 21 December 2001.
[9] V.K. Narendira Kumar & B. Srinivasan " Security Based on Real Time Tracking of Multiple Human Faces Identification", Published Online April 2013 in MECS.
[10] Paul Reid," Biometrics for Network Security", Prentice Hall PTR, December 30, 2003.
[11] Jeffrey E. Boyd and James J. Little," Biometric Gait Recognition",p.1_22, 2010.
[12] L.R Sudha, Dr. R. Bhavani ," BIOMETRIC AUTHORIZATION SYSTEM USING GAIT BIOMETRY", p.1-11, 2007.
[13] Raquel Urtasun and Pascal Fua ," 3D Tracking for Gait Characterization and Recognition",p.1, 2006.
[14] Mark S. Nixon, John N. Carter," ON GAIT AS A BIOMETRIC: PROGRESS AND PROSPECTS",p.1, 2005.
[15] David Cunado, Mark S. Nixon, and John N. Carter," Automatic extraction and description of human gait models for recognition purposes", Academic press,p.1,2002.
[16] Haiyanluo, song ci ,"A Remote Markerless Human Gait Tracking",p.1,2010.