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Mining Sophisticated Patterns and Actionable Knowledge from Massive Moving Object Data

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Abstract

Video surveillance system especially for humans and vehicles, is one of the current challenging research topics in computer vision. The proposed system detects and recognizes objects by extracting object features with different activities in every frame in an images sequence. This paper presents the proposed detection and recognition algorithms. The first step is applying proposed detection algorithm to detect the foreground pixels using the foreground detection model by using multi. The features extracted from each detected object is made by using color, texture, size and shape information in addition to statistical features to facilitate classifying objects by using the combination of three classification techniques (Support Vector Machine, Linear regression and M5 rules). The last step in the proposed system is using the extracted features for object recognition. The proposed system gives acceptable results and can be applied easily by the end user; it enables the user to interact with multiple video scenes and frames. The proposed method is implemented and tested on a wide variety of challenging and adapts the model in background subtraction, classification, the detection process and recognition of objects. Due to many experiments in proposed algorithm, the algorithm is achieves high performance compares with the traditional algorithms of detection and recognition of objects.

Keywords: foreground detection, human tracking, object recognition, classification methods.

1.Introduction

Video surveillance is an active research topic in computer vision that tries to detect, recognize and track objects over a sequence of images and it also makes an attempt to understand and describe object behavior by replacing the aging old traditional method of monitoring cameras by human operators. Object detection and tracking are important and challenging tasks in many computer vision applications such as surveillance, vehicle navigation and autonomous robot navigation. Object detection involves locating objects in the frame of a video sequence. Every tracking method requires an object detection mechanism either in every frame or when the object first appears in the video[1]. Object tracking is the process of locating an object or multiple objects over time using a camera. The high powered computers, the availability of high quality and inexpensive video cameras and the increasing need for automated video analysis have generated a great deal of interest in object tracking algorithms. There are three key steps in video analysis, detection interesting moving objects, tracking of such objects from each and every frame to frame, and analysis of object tracks to recognize their behavior. Therefore, the use of object tracking is pertinent in the tasks of, motion based recognition. Automatic detection, tracking, and counting of a variable number of objects are crucial tasks for a wide range of home, business, and industrial applications such as security, surveillance, management of access points, urban planning, traffic control, etc. However, these applications are no longer playing an important part in consumer electronics. The main reason is that they need strong requirements to achieve satisfactory working conditions, specialized and expensive hardware, complex installations and setup procedures, and supervision of qualified workers. Some works have focused on developing automatic detection and tracking algorithms that minimize the necessity for supervision. The field of machine (computer) vision is concerned with problems that involve interfacing computers with their surrounding environment. One such problem, surveillance, has an objective to monitor a given environment and report the information about the observed activity that is of significant interest. In this respect, video surveillance usually utilizes electro-optical sensors (video cameras) to collect information from the environment[2].

2.Video Playing

Video is captured using a camera or a system of cameras. The system plays the video in the AVI file format. Each camera in proposed system is connected to computer system which works by capturing video imagery from camera and passes it to proposed system for detecting and tracking any human that is selected and needs to be tracked from the first camera in the building. Figure (1) shows the structure of the system.

Figure(1) Monitoring system

3.Capturing

A video sequence is displayed as a series of frames, Thus the video frame is nothing than a still image. The AVI video sequence is split into sequence of frames that are created sequentially as show in Figure (2). The number of frames may be large (30 frames per second) or more. The system needs to get only the frames which represent motions or moving of any object and let any other frames be without any move to reduce time and storage space of these fames. After the frames are split, the frames without similarity are searched to get only different frames which represent new image with new motion which gives information about object tracked.

Figure (2) Sequence of frames

4.Preprocessing

Image pre-processing is the term for operations on images at the lowest level of abstraction. These operations do not increase image information content but they decrease it if entropy is an information measure. The aim of pre-processing is an improvement of the image data that suppresses undesired distortions or enhances some image features relevant for further processing and analysis task. Image preprocessing use the redundancy in images. They include operations related to extracting regions of interest, enhancing specific image features, reducing data in resolution and brightness. Preprocessing is a stage where the requirements are typically obvious and simple, such as removal of artifacts from images or eliminating of image information that is not required for the application.

4.1 Region –of-Interest Image Geometry

Often, for image analysis we want to investigate more closely a specific area within the image, called region of interest (ROI). To do this we need operation that modifies the spatial coordinates of the image, and these are categorized as image geometry operations. The image geometry operations include: Crop and Zoom.

a) Cropping Process

The image crop process is the process of selecting a small portion of the image, a sub image and cutting it away from the rest of the image. This focuses the viewer’s attention on a specific portion of the image and discards areas of the image that contain less useful information. Using image cropping in conjunction with image magnification allows you to zoom in on a specific portion of the image. Image cropping requires a pair of *(x, y)* coordinates that define the corners of the new, cropped image. To crop an image without interactively defining the cursor position, you can use the actual coordinates of the cropped image array in place of the coordinate variables, (LeftLowX, LeftLowY) and (RightTopX, RightTopY). This method can be implemented on image in Figure (3).

Original image cropped image

Figure (3) a) Original image, b)cropped image

Algorithm (1) Cropping region of interest from image

Input: Image file

Output: Cropped image

1: Begin

2: Open the image file, using the R,G,B arguments to obtain the image's color information

3: Get the size of the image and prepare the window display.

4: Crop the image to display only the interesting part,two sets of coordinates, (*LeftLowX, LeftLowY*) and (*RightTopX, RightTopY*), will be used to create the new, cropped image array by:

- defining the lower-left corner of the cropped image by entering the LeftLowX, LeftLowY.
- defining the upper-right corner of the cropped image. Enter the RightTopX, RightTopY.
- Naming the cropped image and defining its array using the lower-left and upper-right *x* and *y* variables.
- preparing a window based on the size of the new array.
- displaying the cropped image.

5: End.

b) Zooming Process

Zooming an image is an important task used in many applications, including the World Wide Web, digital video, DVDs, and scientific imaging. zoom in process applies to image by enlarging it. When zooming, pixels are inserted into the image in order to expand the size of the image, and the major task is the interpolation of the new pixels form the surrounding original pixels. This is done by using First _Order Hold.

First _Order Hold is performed by finding linear interpolation between a adjacent pixels, i.e., finding the average value between two pixels and using that as the pixel value between those two as follows:

Original Image Array **Image with Rows Expanded**

$$\begin{bmatrix} 8 & 4 & 8 \\ 4 & 8 & 4 \\ 8 & 2 & 8 \end{bmatrix} \longrightarrow \begin{bmatrix} 8 & 6 & 4 & 6 & 8 \\ 4 & 6 & 8 & 6 & 4 \\ 8 & 5 & 2 & 5 & 8 \end{bmatrix}$$

This method allows us to enlarge an N×N sized image to a size of (2N-1) ×(2N-1) and be repeated as desired see Figure (4).

Original image cropped image

Figure (4) a) Original image, b)cropped image, c) zooming image

5.Foreground Detection[3]

Foreground detection is an essential task in many applications and a commonly used approach to obtain foreground objects from the background. Many techniques exist, but due to shadows and changes in illumination, the detection of foreground objects from the background remains challenging. The most popular method for foreground detection is background subtraction where a background model needs to be maintained. This system use a method for detecting objects based on texture, color and edge measure. This method is characterized by robustness against illumination changes, shadows and little background changes. The algorithm for detecting moving objects in using a background model based on different features by computing similarity measure for each component features. So, for each pixel, color, texture and edge similarity measures are computed as explained in section 2 from the background and the current image.
We define the set of criteria, color features of the chosen color space (RGB,HSV,YCbCr), texture feature and edge feature.

$$\mathbf{M(x,y) = SH_3\,(x,y)*0.2+ SY_1\,(x,y)*0.2+ SY_2\,(x,y)*0.3+ S^T\,(x,y)*0.25+SR(x,y)*0.05} \quad \ldots(1)$$

where SH_3 (x,y) is the value component (v) in HSV color space, SY_1 (x,y) is the luminance component(Y) in YCbCr color space, SY_2 (x,y) is the chrominance component(Cb) in YCbCr color space, SR(x,y) is the RGB color space, S^T (x,y) is the texture and E(x,y) the Laplacian filter for edge detection. The pixel at position (x,y) is considered as foreground if its value is less than a certain threshold and edge similarity measure is equal to zero..
if M (x, y) < Th then (x,; y) is foreground.

Algorithm(2) Foreground detection

Input: Current frame, background frame.
Output: Moving objects. 1: Begin 2: Do Until not EOF(image file). 3: Convert RGB to HSV color space for both current image, background image and extract the value (V). 4: Convert RGB to YCbCr color space for both current image, background image and extract the luminance (Y) and chrominance (Cb) components. 5: Find Local Binary Pattern (LBP) texture measure for current image and background image. 6: Use Laplacian operator to detect edges in current image and background image. 7: Calculate similarity measure for all extracted features components. 8: Apply the equation (4-6) 9: if the result under threshold and edge similarity measure is equal to zero then pixel is foreground. 10: End.

6.Feature Extraction

The goal in image analysis is to extract information useful for solving application based problems. This is done by intelligently reducing the amount of image data with the tools explored, including edge detection\ following and segmentation. After you have performed these operations, you have modified the image from the lowest level of pixels data into higher- level representations[4].

6.1 Color features

6.1.1 RGB Color Space

RGB is a color space originated from Cathode-Ray Tube (CRT) (or similar) display applications. which can be defined by using red, green, and blue as primary colors, denoted, respectively, by R, G, and B. It is one of the most widely used colors paces for processing and storing of digital image data. The RGB color format is mainly used in computer graphics, because color monitors use red, green, and blue phosphors to generate desired colors [5].

6.1.2 HSV color space

HSV color Space stands for hue (H),saturation (S) and value (V). The hue which is essentially the chromatic component of our perception may. Saturation is a measure of colorfulness or whiteness in the color perceived. The value (V) essentially provides a measure of the brightness of colors[6].

6.1.3 YCbCr color space

The color space in which luminance and chrominance are separately represented is the *YC*b*Cr,* where *Y*, *Cb* , and *Cr* components are scaled and shifted versions of the *Y*, *U*, and *V* components. The *Y* component takes values from 16 to 235, while *Cb* and *Cr* take values from 16 to 240[7].

6.2 Shape Features

6.2.1 Center of Area

The center of area used for determining the area of object and find the center of this area, this is done by using equations[8].

$$\overline{r}_i = \frac{1}{A_i}\sum_{r=0}^{N-1}\sum_{c=0}^{N-1} r f_i(r,c) \qquad \text{...... (2)}$$

$$\overline{c}_i = \frac{1}{A_i}\sum_{r=0}^{N-1}\sum_{c=0}^{N-1} c f_i(r,c) \qquad \text{...... (3)}$$

6.3 Size Features[9]

6.3.1 Area

The area feature is used to measure the actual size of the object by calculating the number of pixels and indicating the relative size of the object for recognition by applying the equation

$$f_i(r,c) = \begin{cases} 1 & \text{if } f(r,c) = i \text{ th object number} \\ 0 & \text{otherwise} \end{cases} \qquad \text{...... (4)}$$

6.3.2 Length and Width

These features are used to calculate the horizontal and vertical extent of human for determining the dimensions of the object to help in the recognition.

6.4 Statistical Features

Feature extraction is the first step in performing the classification and interpretation of images. In the statistical feature extraction of statistical parameter of the image of interest, there are four parameters being extracted for the first order and second order statistics.

6.4.1 Mean: It shows the size of the dispersion of an image[10].

$$\mu = \frac{\sum_{i=0}^{G-1} ip(i)}{\sum_{i=0}^{G-1} p(i)} = \frac{\sum_{i=0}^{G-1} ip(i)}{n} = \sum_{i=0}^{G-1} iP(i) \quad \text{...... (5)}$$

6.4.2Variance : The variance is a measure of the histogram width, that is, a measure of how much the gray levels differ from the mean[10].

$$\sigma^2 = \sum_{i=0}^{G-1} (i-\mu)^2 P(i) \quad \text{...... (6)}$$

6.4.3Skewness: is a measure of the degree of histogram asymmetry around the mean[10].

$$m_3 = \sum_{i=0}^{G-1} (i-\mu)^3 P(i) \quad \text{...... (7)}$$

6.4.4 Angular second moment: ASM is a feature that measures the smoothness of the image. The less smooth the region is, the more uniformly distributed *P*(*i*, *j*) and the lower will be the value of ASM[11].

$$ASM = \sum_{i=0}^{N_g\ 1} \sum_{j=0}^{N_g\ 1} (P(i,j))^2 \quad \text{...... (8)}$$

7. Classification

Classification is one step in the process of data mining. It is used to group items based on certain key characteristics. There are several techniques used for data mining classification. The main classification algorithms used in proposed system are Support Vector Machine, Linear regression and M5 rules.

7.1 Support Vector Machine (SVM)

The algorithm maintains a candidate Support Vector set. It initializes the set with the closest pair of points. As soon as the algorithm finds a violating point in the dataset it speedily adds it to the candidate set. It may so happen that addition of the violating point as a Support Vector may be prevented by other candidate Support Vectors already present in the set. You simply prune away all such points from the candidate set.

Algorithm (3) SVM classification algorithm

Input: Objects features
Output: Classified object 1: Begin 2: Finding the Closest Pair of Points 3: Adding a Point to the Support Vector Set to made support vector 4: Pruning (identified and pruned the Blocking points) 5: Determine an error bound. 6: Find a closest pair from opposite classes violator Candidate repeat untill all such points are pruned 7: Scaling (the memory requirements of the algorithm scale up as $O(\|S\|^2)$ in the average case to store the values of αs corresponding to the candidate Support Vector set (S) . 8: End.

7.2 Linear Regression (LR)

A regression is a statistical analysis assessing the association between two variables. It is used to find the relationship between two variables. linear regression is an approach for modeling the relationship between a scalar dependent variable *y* and one or more explanatory variables denoted by *X*. The case of one explanatory variable is called simple linear regression. For more than one explanatory variable, the process is called *multiple linear regression*.

Regression Equation(y) = a + bx

Slope(b) = $(N\Sigma XY - (\Sigma X)(\Sigma Y)) / (N\Sigma X^2 - (\Sigma X)^2)$

Intercept(a) = $(\Sigma Y - b(\Sigma X)) / N$

Where: x and y are the variables.

b = The slope of the regression line , a = The intercept point of the regression line and the y axis.

N = Number of values or elements , X = First Score , Y = Second Score

ΣXY = Sum of the product of first and Second Scores,

ΣX = Sum of First Scores , ΣY = Sum of Second Scores

ΣX^2 = Sum of square First Scores

To find regression equation, we will first find slope, intercept and use it to form regression equation.

Input: Objects features
Output: Regression equation 1: Begin 2: Count the number of values. 3: Find first with second Scores, the square of first score 4: Find Sum of First Scores, Sum of Second Scores, sum of first with second Scores, Sum of square First Scores. 5: Substitute in the above slope formula given. 6: Substitute in the above intercept formula given. 7: Then substitute these values in regression equation formula Regression Equation 8: End

Algorithm (4) Linear Regression

7.3 M5 Rules

M5 is a system for learning models that predict values of M5 builds tree based models. The first step in building a model tree is to compute the standard deviation of the target values of cases in T, (where T has a collection of tree cases).Unless T contains very few cases or its values vary only slightly, T splits on the outcome of a test. Every potential test is evaluated by determining the subset of cases associated with each outcomes of a test. Let Ti denote the subset of cases that have the ith outcome of the potential test. If you treat the standard deviation sd(Ti) of the target values of cases in Ti as a measure of error, the expected reduction in error as a result of this test can be written as:

$$\Delta error = sd(T) - \sum_i \frac{|T_i|}{|T|} \times sd(T_i).$$

……(9)

Algorithm (5) M5 classification

Input: Objects features
Output: Classified object 1: Begin 2: (Error estimates) estimate the accuracy of a model 3: Construct the linear model using standard regression techniques. 4: Compare the accuracy of a linear model with the accuracy of a sub tree to ensure be the same information. 5: Eliminate parameters to minimize its estimated error. uses a greedy search to remove variables that contribute little to the model. 6: Select the final model for this node either the simplified linear model or the model sub tree, depending on which has the lower estimated error. If the linear model is chosen, the sub tree at this node is pruned to a leaf. 7: Smooth process to compensate the sharp discontinuities 8: End

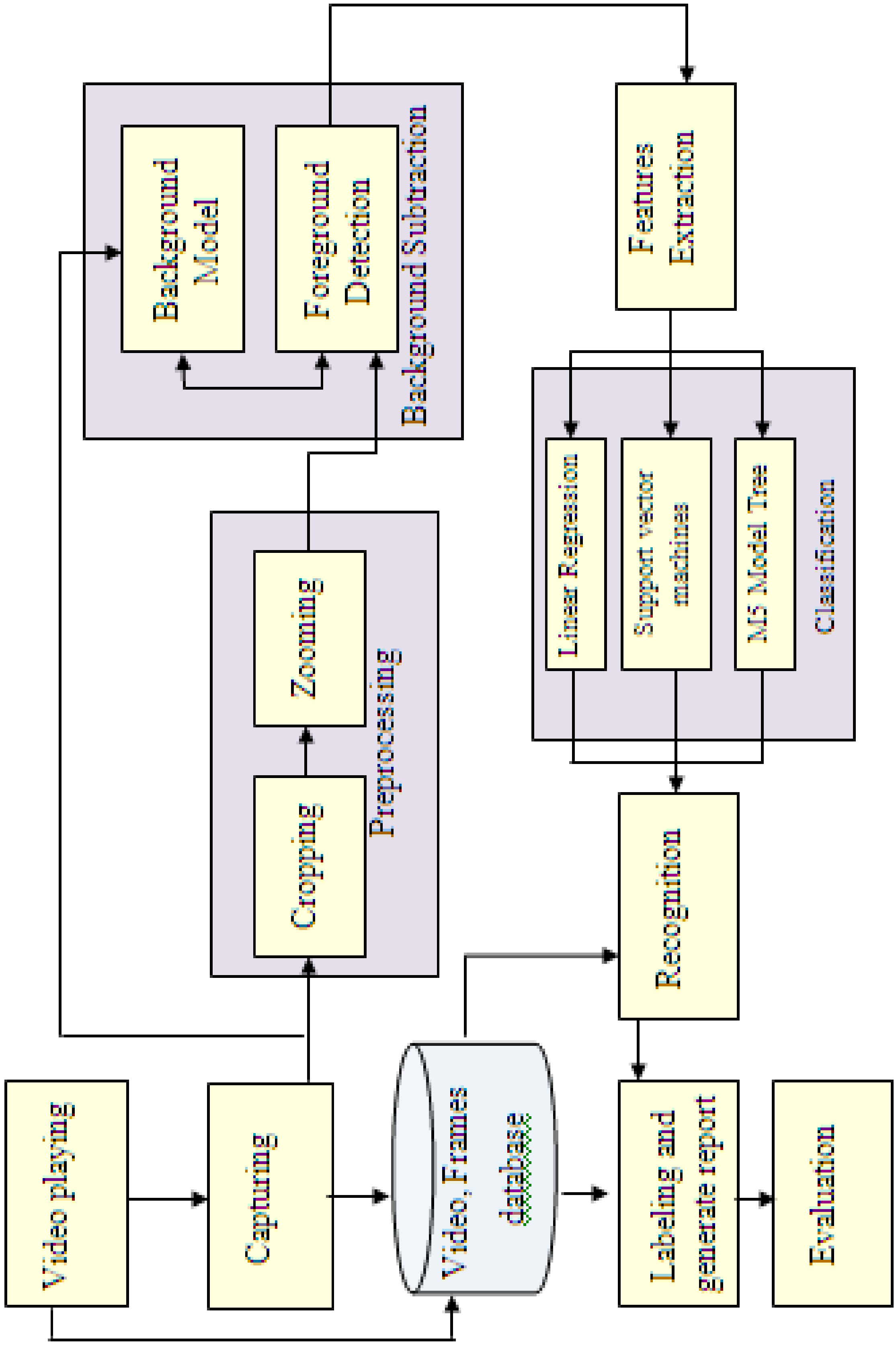
After examining all possible tests, M5 chooses one that maximizes this expected error reduction. The major innovations of M5 come into play after the initial tree has been grown.

8. The Proposed System

The idea of the proposed algorithm depends on the monitoring of any building by using a number of static cameras put in different places in this building. The system consists of cameras attached to monitor screens. This system is installed to give an overview of a large area to a limited number of operators. Operators often work in a room with lots of monitors. Monitors show the video stream of a single camera. Video recorders record the output of each camera and at any time video footage can be used. The general block diagram of the proposed system would be as in Figure (5). The system plays the AVI video file format that is captured by using a camera or a system of cameras, this video is split into sequence of frames that are created sequentially, preprocessing can be used for enhancing specific image features, Foreground detection approach is used to obtain foreground objects from the background. The features of the detected object are extracted by color, texture, size and shape information in addition to statistical features for classification. There are several classification techniques used in proposed system they are Support Vector Machine, Linear regression and M5 rules. Recognition algorithm applied by using different features of statistical, color, size, shape, and texture for human recognition, then the recognized human object is labeled.

8.1 Proposed Features Extraction Algorithm

The proposed system detects the object by initially extracting distinctive invariant features from images. The selected features reflect color, texture, size and shape information in addition to statistical features. The combined set of features is usually very effective to distinguish objet and provide more reliability. Feature extraction refers to the process of forming a new set of features from the original and suspected features set, and find a mapping



Figure(5) The proposed system flowchart

that reduces the dimensionality of pattern by extraction some numerical measurements from raw input pattern. Feature vector is one method to represent an image. or part of an image. by finding measurements on a set features. The feature vector is an n-dimensional that contains these measurements. The vector provides us with high- level information. The feature extraction process is illustrated in Figure (6).

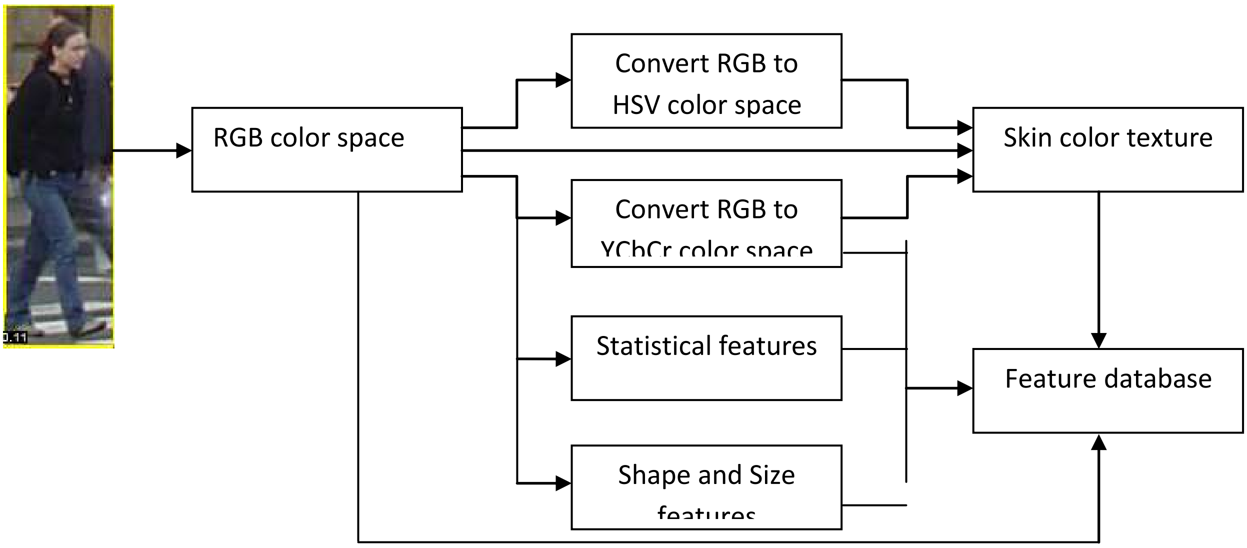


Figure (6) Feature extraction flowchart

Algorithm(6) Feature Extraction

Input: Extracted moving object

Output: Selected features
1: Begin
2: Do Until not EOF(image file).
3: Separate the objects color space component to three channels (R,G,B).
4: Convert RGB color space to HSV color space for moving object by HSV color transformation.
5: Convert RGB color space to YCbCr color space for moving object and extract the luminance (Y) and chrominance (Cb), (Cr) components.
6: apply the H, Cr and RGB threshold corresponding to the skin texture value to extract the human skin color texture.
7: Find the shape feature (Center of area) feature.
8: Find the size features (area, Length and Width) for the human object.
9: Extraction of statistical features
First-order statistical features (mean, variance, skew and Kurtosis) for the human object Second-order statistical features(Angular Second Moment (ASM)).
10: End.

8.2 Proposed Object Recognition Algorithm

In the proposed recognition system, shown in Figure (6), different features of statistical, color, size, shape, and texture are combined together for their applications in the human recognition. Normally, by increasing the features used, the performance of the methods proposed can be increased. Moreover, both surface information (color and texture) and geometry information (size and shape) of human in images play a significant part in defect detection and class discrimination. In color feature the system needs more than one color space of the images, in order to obtain one channel containing the luminance information and two other channels containing chrominance information by using YCbCr color space, in addition to RGB color space.

The two sections involved in this work are Training and Classification. The block diagram of the proposed method is given in Figure (7).

In the classification phase, for the test human object, statistical, color, shape, size and texture features are derived as that of the training phase and compared with corresponding feature values, stored in the feature library. The classification is done using the Minimum Distance Criterion. The object from the training set which has the minimum distance when compared with the test object says that the test object belongs to the category of that training image.

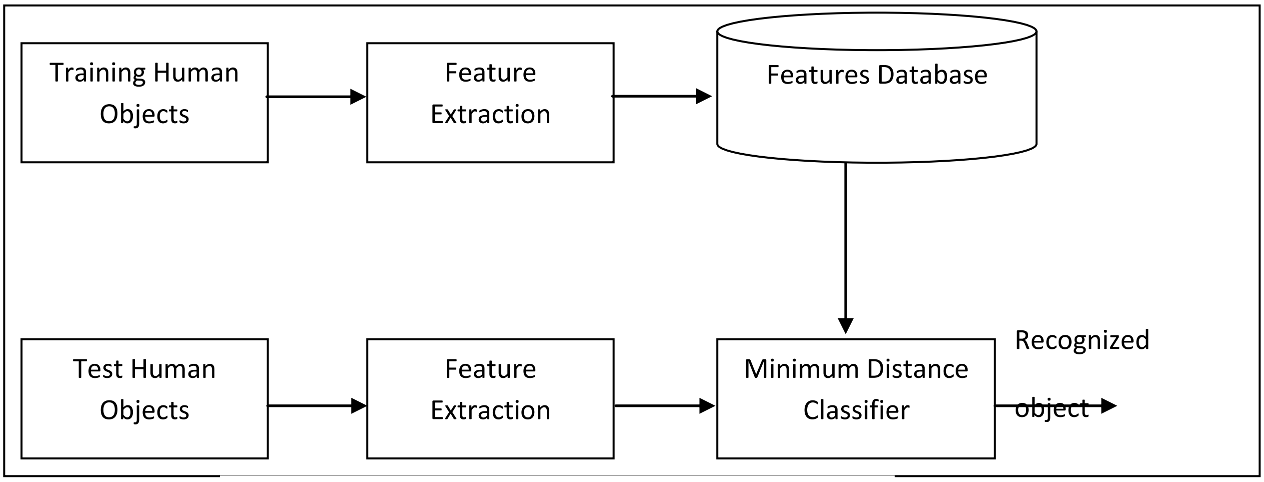


Figure (7) Human object Recognition System

In the recognition stage the process is done in number of steps as follows:

1. using the (RGB) color space as filter for the initial recognition process.

The system uses R,G and B color values of the selected human object by calculating the sum of each color band and selecting the maximum color value for this human object and doing the same process with all extracted objects and then comparing the results.

2. The statistical features are used as a second filter for recognition process.

The statistical features that are extracted from selected object in the stage 5 are used for comparing with the same features that are extracted from all other objects to find the closest results.

3. The skin color that is extracted from the human object is subdivided on the area of the object to find the percentage of the skin color to area and compare with the percentage of all extracted human objects.
4. The final step in recognition system is done by using the size and the shape features with the YCbCr color space.

The geometry information(size and shape) which includes center of area, length and width features of human and the color features are computed from the chrominance channels Cb and Cr, all these features are subdivided on the area of the object to find the percentages of each one of these features to area and compare with the percentage of all extracted human objects.

Algorithm (7) Human object recognition

Input: Features of selected human object, features of many extracted human objects
Output: Recognize human object
1:Begin
2: Do Until no extracted object
3: Calculate the sum of R color value, sum of G color value, sum of B color value for both selected object and all extracted objects.
4: Find the maximum color value from R,G,B color values.
5: Compare mean, variance, skew and energy of the selected object with the extracted objects.
6: Find the ratio of skin color to area for the selected and extracted objects then compare the results.
7: Find the ratio of center of area, length, width, Cb and Cr features to area for the selected and extracted object then compare the results.
8: End

8.3 Human Object Labeling

After the human object is detected, tracked and saved, it is labeled. The primary aim of the object extraction tool is to decrease the manual work that is required in detection and recognition system, shown in Figure (8). This process improves the performance of the system by giving the description in detail for all locations in the human reach from the locations of cameras. Then the written report is produced about the object movements.

Figure (8) Labeling human object

9. Proposed System Implementation

The implementation of the proposed system will from our point of view consist of seven basic procedures as follows:

1. The video playing and capturing
2. The preprocessing which include
3. The proposed foreground detection
4. The feature extraction
5. The classification process
6. Applying the proposed human object recognition algorithm.
7. Object Labeling
8. System Evaluation

9.1 The Video Playing and Capturing

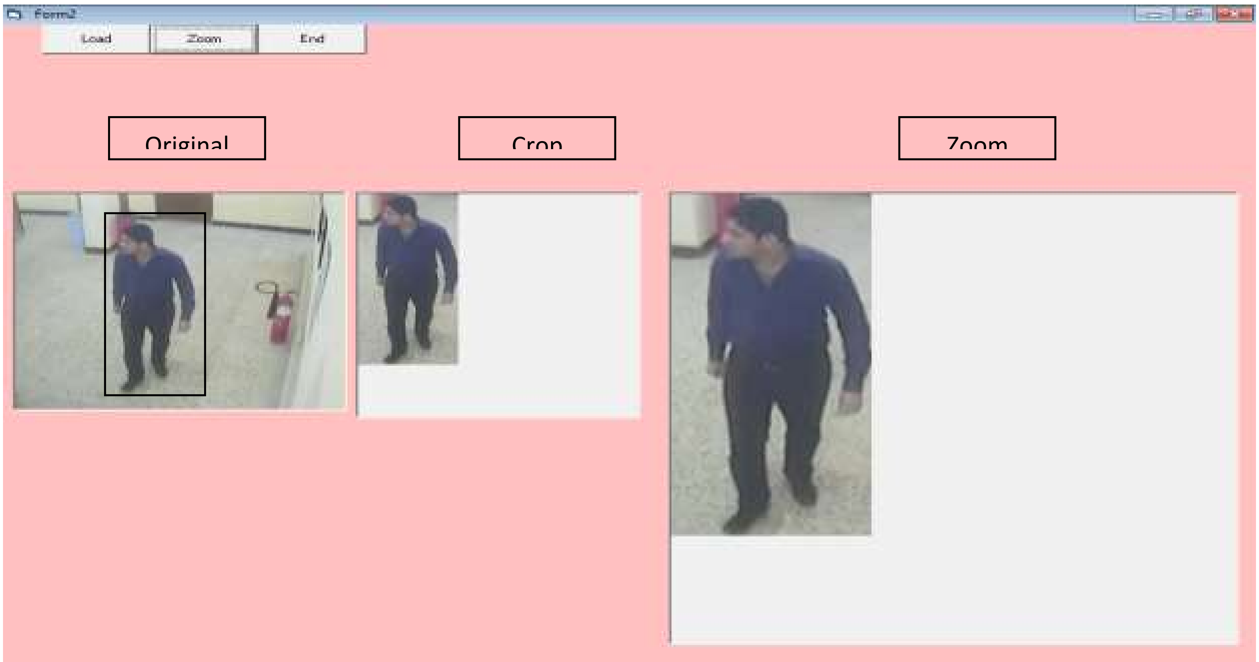
The system starts by implementing a video player application to capture the video film, see Figure (9) and then it is passed to the analyzer to split this video film to many frames per second, these frames are fed to proposed algorithms for processing, as shown in Figure (10)

Figure (9) AVI Video movies

Figure (10) sequences of frames

9.2 The Preprocessing

Image preprocessing includes the following two steps which can be used by the user of the system. as shown in Figure (11).



Figure(11) Object crop and zoom for one frame in Figure(5.2)

9.3 The Foreground Detection

Many image sequences from public domain are adopted as benchmark, which are taken from various types of scenes. The foreground objects detected by this method are more accurate than previous methods. This method is more robust against the noise due to light actuation. Cast shadows caused by the foreground objects are also detected well in all test sequences. Figure(12) shows the results of the test sequence.

(a) (b) (c)

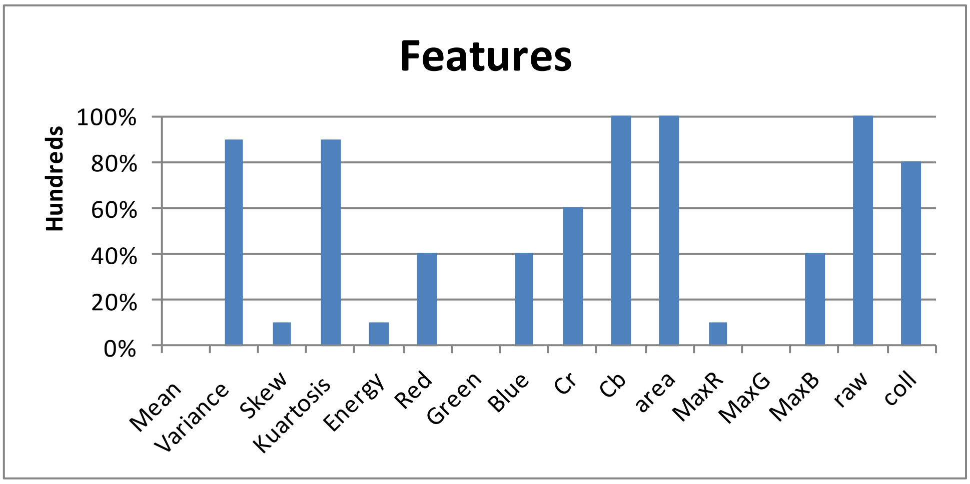
Figure (12): (a) represents current image. (b) represents background image. (c) represents the moving object.

10 The Feature Extraction

The training set has been collected from each class, many features are used to determine if the object is in class or not. The goal is to use only the necessary information. This process minimizes the cost of the digital image classification. In this step the system displays the results of object features as shown in Table(1) for the object in Figure (13) with different activities.

Figure (13) Human object samples

The system applies all the features of the objects in Table(1),(for classification and recognition but not all these features succeed in classification see Figure (14), therefore the system tests these features to select the best features and extract rule for classification process. These features are shown in Figure (15).

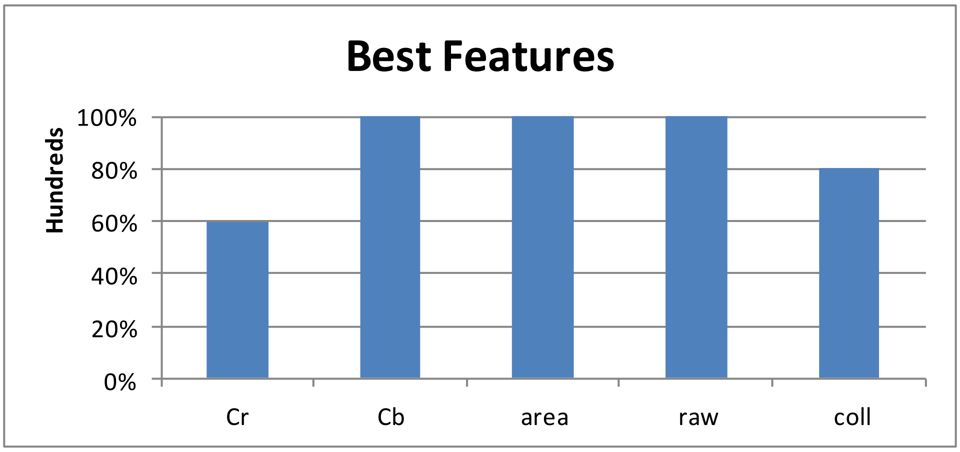


Figure(14)Samples of features extracted for classification

Table (1) The color features in different color spaces, statistical, size and skin color features for the object in Figure (13)

Red	Green	Blue	Hue	Saturation	Cb	Cr	Max	meanr	meang	meanb
2283362	1339029	1431519	132290.8866	10715.54858	3853132.978	3684411.397	15983	89.20432082	52.31195062	55.92526468
2609333	1506619	1599641	155135.7808	15658.42999	4319885.554	4147374.884	18396	91.00948694	52.54856824	55.79299641
5530415	3309565	3505097	312249.6596	20099.0649	8047595.588	7614510.378	33927	106.3950558	63.66998846	67.43164679
9548297	5431200	5836103	606141.1854	32069.744	12778717.97	12162657.47	51663	117.6985886	66.94853621	71.93963636
1296992	775752	871411	79474.1098	6886.584633	2523480.413	2396752.571	10735	76.33855209	45.65944673	51.28969982

mean	variance	skew	kuartosis	energy	area	raw	coll	skincounn	skinncb	skinncr
3678599.21	1.2649	-4.636	1.6993	6.9003	25597	674	248	1372	233770.937	209230.949
3669993.256	1.4052	-5.135	1.8766	7.7284	28671	751	253	1670	283182.531	254604.59
4435606.316	4.4781	-1.973	8.6979	1.7988	51980	1052	382	3356	574141.213	511717.558
4731892.533	8.4352	-3.954	1.8537	2.8929	81125	1149	379	5206	888610.42	801582.567
3373086.925	6.4887	-2.183	7.3467	3.857	16990	584	181	1372	233770.937	209230.949



Figure(15) Best features extracted for classification

5. The Classification Process

There are three main types of classification of algorithms; these methods are used to recognize the features of the image. These types are Support Vector Machine, Linear regression and M5 rules. The best results for classification in these methods are shown in Figures(16,17,18).

a) Support Vector Machine

The results of classification in Support Vector Machine are shown in Table(2) and Figure (16):

Table (2) The results of classification in Support Vector Machine

Correlation coefficient	0.9918
Relative absolute error	4.9276 %
Root relative squared error	5.4248 %

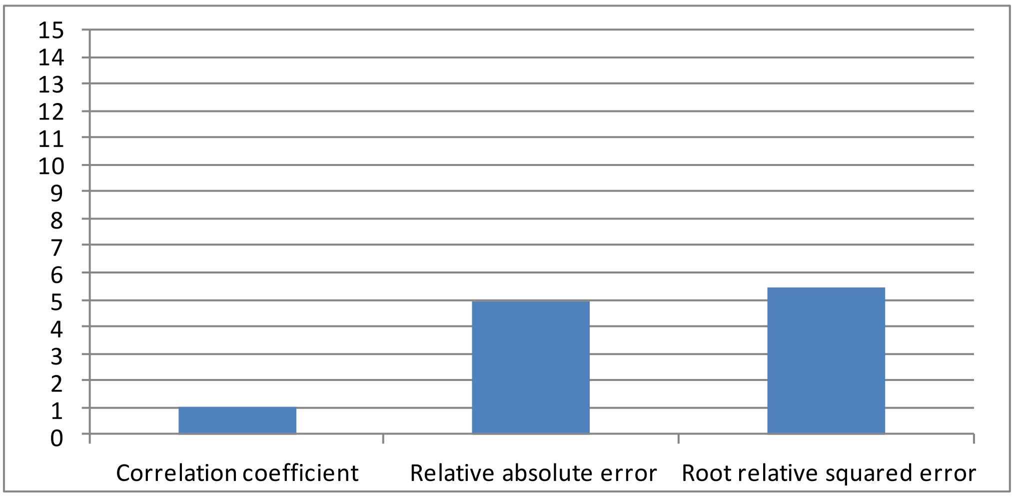


Figure (16) Flowchart of classification results in Support Vector Machine

b) Linear Regression

The results of classification in Linear regression are shown in Table(3) and Figure (17):

Table (3) The results of classification in Linear regression

Correlation coefficient	0.999
Relative absolute error	12.7616 %
Root relative squared error	12.3879 %

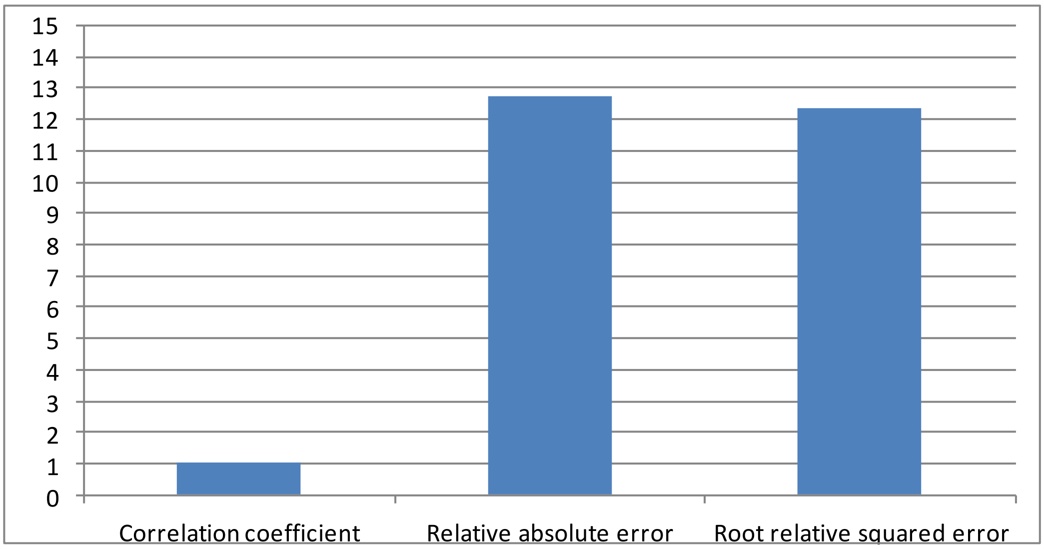


Figure (17) Flowchart of classification results in Linear regression

c) M5 rules

The results of classification in M5 rules are shown in Table(4) and Figure (18):

Table (4) The results of classification in M5 rules

Correlation coefficient	0.9999
Relative absolute error	1.7947 %
Root relative squared error	1.7172 %

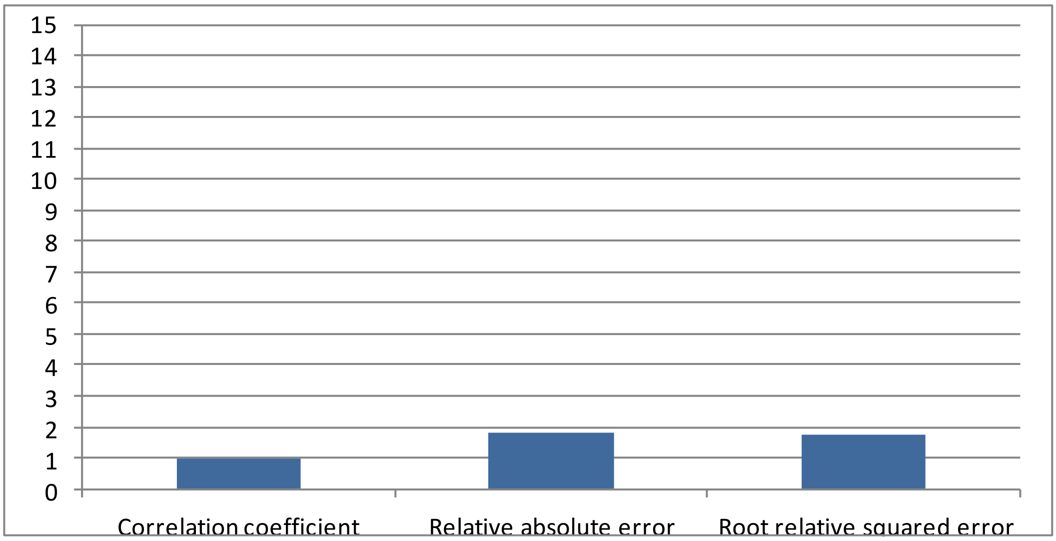


Figure (18) Flowchart of classification results in M5 rules

6. Proposed Human Object Recognition Algorithm

For object recognition many filters are applied as described in chapter four, these filters use different features of statistical, color, size, shape, and texture combined together for recognition.

1. using the (RGB) color space as filter for the initial recognition process.

The system uses R,G and B color values of the selected human object by calculating the sum of each color band and selecting the maximum color value for this human object. The same process is done with all extracted objects and then the results are compared as shown in Table(5).

Table (5) The R, G and B color values with mean of each color band and maximum value extracted from object for recognition

Red	Green	Blue	Max	meanr	meang	meanb
2283362	1339029	1431519	15983	89.20432082	52.31195062	55.92526468
2609333	1506619	1599641	18396	91.00948694	52.54856824	55.79299641
5530415	3309565	3505097	33927	106.3950558	63.66998846	67.43164679
9548297	5431200	5836103	51663	117.6985886	66.94853621	71.93963636
1296992	775752	871411	10735	76.33855209	45.65944673	51.28969982

2. The statistical features are used as a second filter for recognition process as shown in Table (6).

Table (6) Statistical features extracted from object for recognition

mean	variance	skew	kuartosis	energy
5601523.403	6.3404	-3.54	1.9768	1.686
5564619.226	1.0519	-5.821	3.2213	2.9136
5947601.812	1.084	-6.418	3.8007	2.6154
5306403.288	7.3586	-3.886	2.0522	2.092
4482738.658	4.3229	-1.927	8.5908	1.5173

3. Extract the skin color from the human object are subdivide it on the area of the object to find the percentage of the skin color to area and compare with the percentage of all extracted human objects as shown in Table(7).

Table (7) The skin color features extracted from object for recognition

Skin area	skinncb	skinncr
1372	233770.937	209230.949
1670	283182.531	254604.59
3356	574141.213	511717.558
5206	888610.42	801582.567
1372	233770.937	209230.949

4. The final step in recognition system is done by using the size and the shape features with the YCbCr color space as shown in Table(8).

Table (8) The Cb, Cr color with the size and the shape features extracted from object for recognition

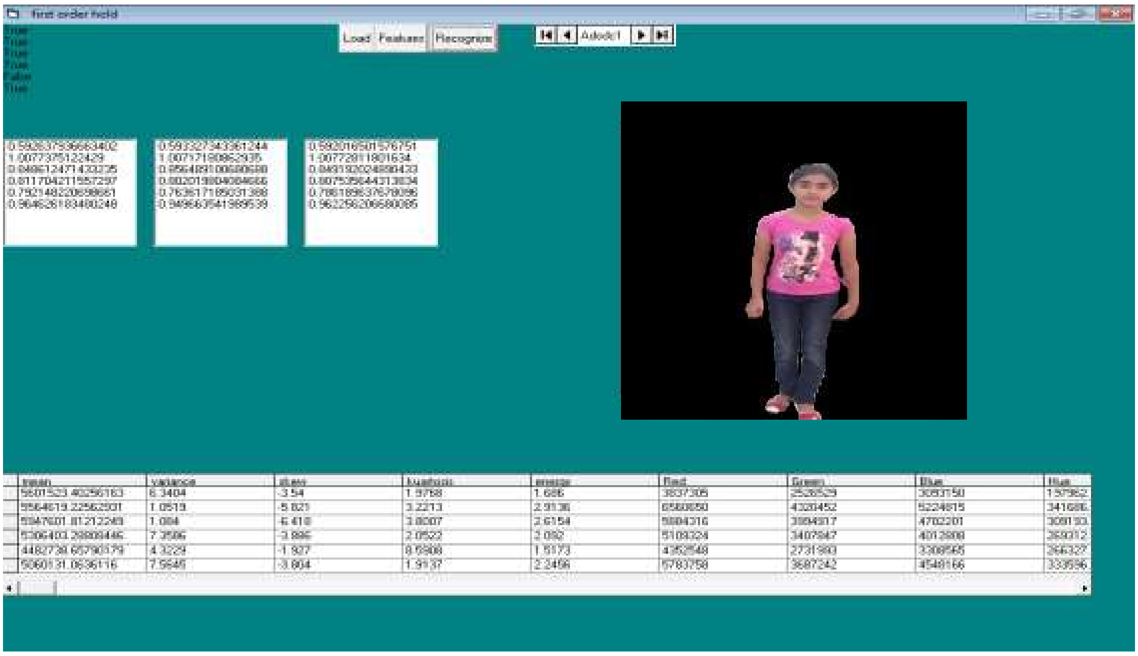
Cb	Cr	area	raw	coll
3853132.978	3684411.397	25597	674	248
4319885.554	4147374.884	28671	751	253

8047595.588	7614510.378	51980	1052	382
12778717.97	12162657.47	81125	1149	379
2523480.413	2396752.571	16990	584	181

The geometry features of human and the chrominance channels Cb and Cr colors are compared, all these features are subdivided on the area of the object to find the percentages of each one of these features to area and compare with the percentage of all extracted human objects, shown the Figures,(20),(22)and (24).

In Figure (20) the object features are compared with the features of the same object in different sizes and directions and the same location and colors as shown in Figure (19). The program recognizes the object with high percent, the list of comparison results is shown.

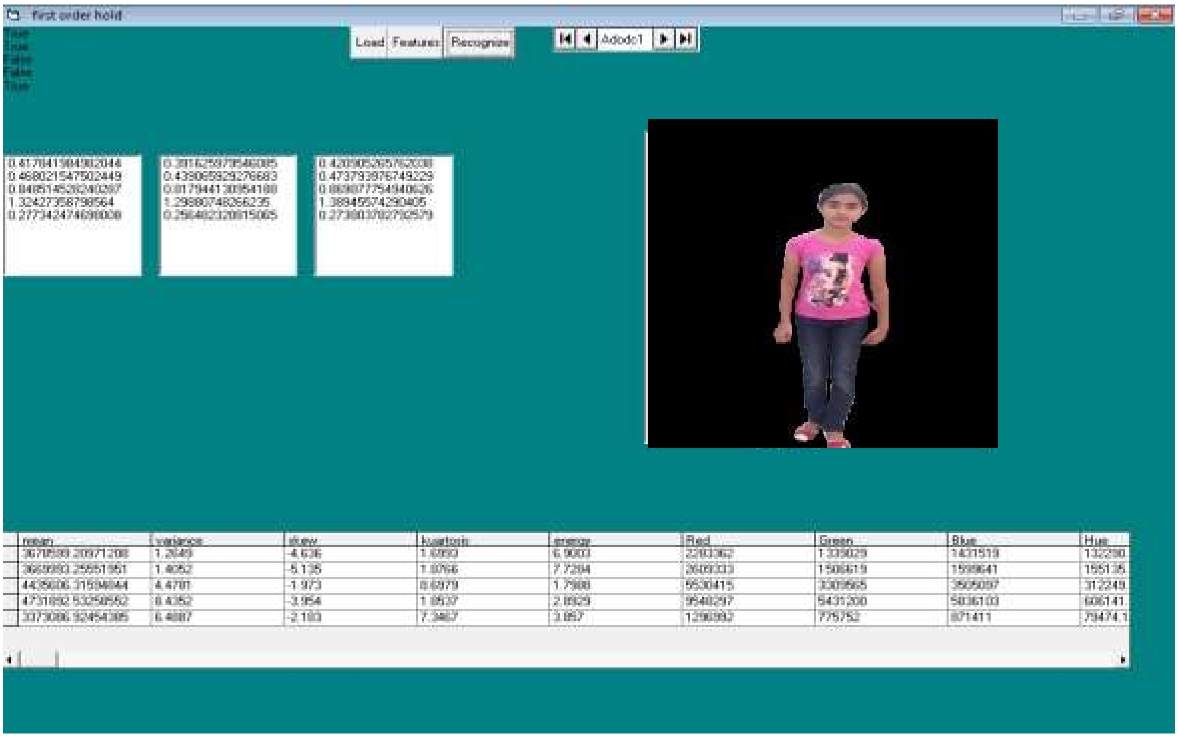
Figure (19) Human object in different sizes and directions



Figure(20) The object matching to the same person with the same location

In Figure (22) the object features are compared with the features of the same object in different sizes and directions but in another location and colors as shown in Figure (21). The program recognizes the object with middle percent, the list of comparison results is shown.

Figure (21) Human object in different sizes and directions



Figure(22) The object matching to the same person in another location

In Figure (24) the object features are compared with the features of another object in different size and directions as shown in Figure (23). The program doesn't recognize the object with high percent, the list of comparison results is shown.

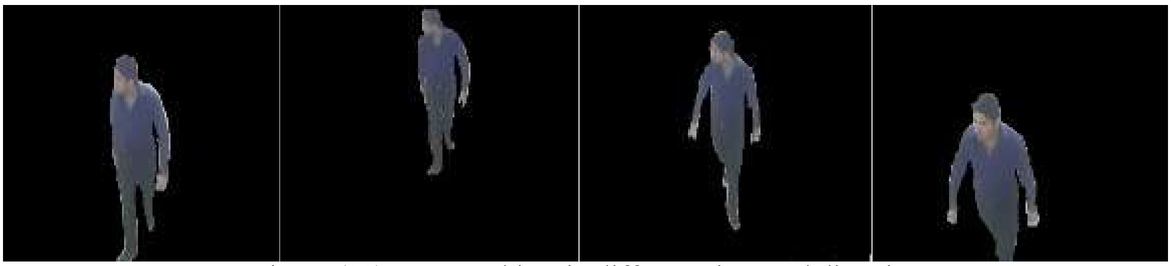
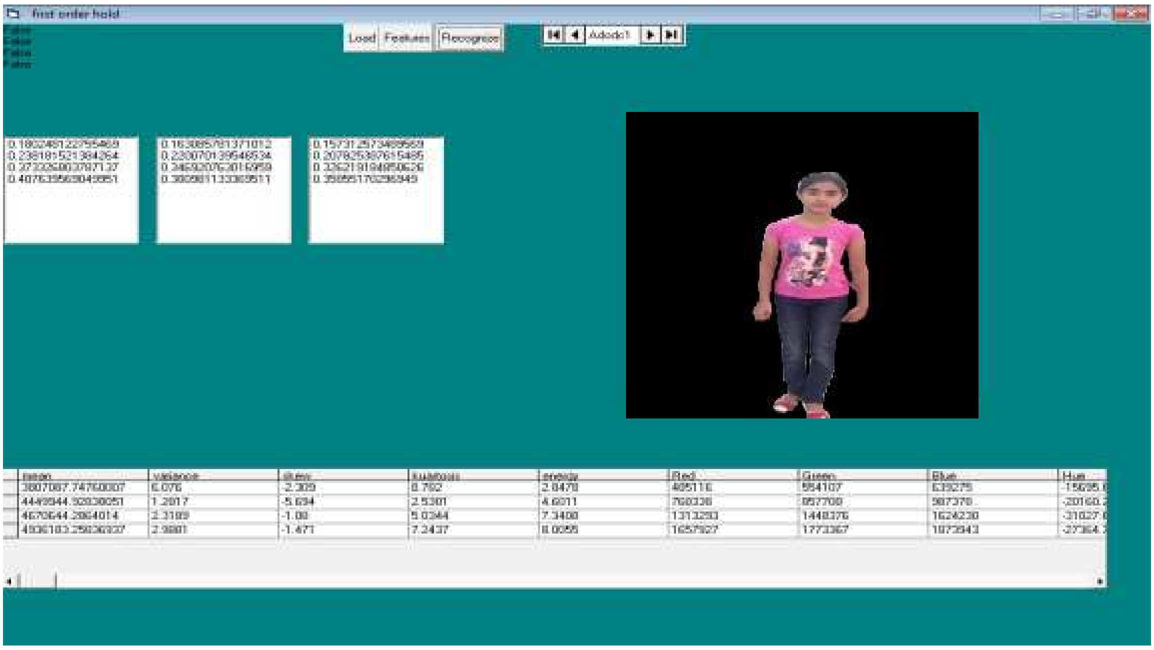


Figure (23) Human object in different sizes and directions



Figure(24) The object doesn't match the other person

7. Object Labeling

After detecting the human object, it is labeled as shown in Figure (25). Then the description is given in detail for all locations of the human reached from the locations of cameras.

Figure (25) Labeling human objet in different locations.

8. System Evaluation

The performance of the proposed system is evaluated to check the effectiveness of the proposed method. The proposed method is implemented and tested on a wide variety of challenging. The proposed method adapts the model in background subtraction, classification, the tracking process and recognition. The method selects shape, color, texture and statistical features and tracks the man successfully until the man becomes too small to be tracked.

10. Conclusion

In this paper, we have presented a The proposed method can process, analyze and recognize human based on color and texture features. In order to improve the functionality and flexibility of the recognition system statistical, shape and size features can be combined together with color and texture features. Further, by increasing the number of images in the database the recognition rate can be increased. This thesis describes the proposed methods for background subtraction, object detection, recognition and person identification for applications in visual surveillance. In texture similarity; texture-based method for background subtraction is based on the Local Binary Pattern (LBP) texture measure. The LBP is a powerful means of texture description. The operator labels the pixels of an image block by thresholding the neighborhood of each pixel with the center value and considering the result as a binary number.

REFERENCES

[1] Ka Ki Ng, "Background Subtraction and Object Tracking with Applications in Visual Surveillance" Ph.D thesis, Purdue University,West Lafayette, Indiana, December 2011.
[2] Mrinali M. Bhajibhakare, Pradeep K. Deshmukh," To Detect and Track Moving Object for Surveillance System",International Journal of Innovative Research in Computer and Communication Engineering , Vol. 1, Issue 4, June 2013.
[3] Emad K.Jabbar,Ahmed T.Sadiq,Nuha J.Ibrahim, "Foreground detection by using multi features",
[4] Gonzales, R. C. and Wintz, P., "Digital image Processing", Addison Wesley Pub. Company, 1987.
[5] Rastislav L., Konstantions N.Plataniotis, (2007), "Color Image Processing Book", CRC Press, ISBN-13 978-0-8493-9774-5.
[6] Xu Zhao,Yun Fu, Yuncai Liu," Human Motion Tracking by Temporal-Spatial Local Gaussian Process Experts" , IEEE Transactions on Image Processing, VOL. 20, NO. 4, APRIL 2011 .
[7] B. Muthukumar, S.Ravi, "Tracking the Human Motion in Real Time using Star Skeleton Model ", International Journal of Engineering and Advanced Technology (IJEAT), Vol.1, Issue-3, February 2012.
[8] Michael Alder, "An Introduction to Pattern Recognition", Computer Based Learning Unit, University of Leeds, 2001.
[9] Joaquim P. Marques de Sa, "Pattern Recognition Concepts, Methods and Applications", Oporto University, Portugal, May, 2001.
[10] Uyun, Sri Hartati, Agus Harjoko, Subanar, "Selection Mammogram Texture Descriptors Based on Statistics Properties Back propagation Structure Shofwatul ",(IJCSIS) International Journal of Computer Science and Information Security, Vol. 11, No. 5, May 2013.
[11] Namita Aggarwal, R. K. Agrawal, "First and Second Order Statistics Features for Classification of Magnetic Resonance Brain Images", Journal of Signal and Information Processing, 3, 146-153, Published Online May 2012.