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RECOGNITION OF FACES IN THE CROWD USING BIOMETRIC TECHNOLOGIES MIXED

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Abstract: *This paper aims to develop under Microsoft Visual Studio, a practical application detection and recognition of people using Haar classifiers in conjunction with an algorithm personal centroid detection of eye gaze direction. The method uses biometric technology cubic interpolation. To describe as the best option data and identify them in a two-dimensional space we used principal component analysis (PCA). Using PCA, we can identify two-dimensional plane which best describes the varied data.The work aimed at obtaining recognition rate of 100% and a real-time processing.*
Keywords: *PCA, cubic interpolation, classifiers, faces recognition, HAAR-like, centroid*

1. Methods of extracting and selecting features from a video

1.1. Generalities

Extraction and selection of features (feature extraction and selection) of visual forms represent two important steps on the success and performance of the recognition or identification form (pattern recognition) (fig. 1.1.1.)

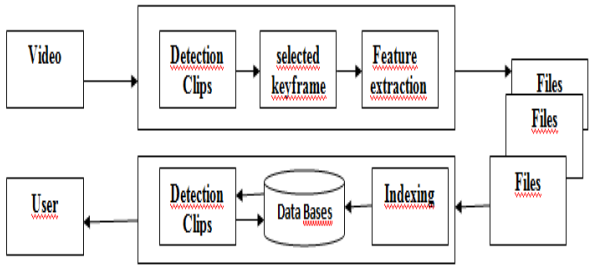

Fig. 1.1. Extraction and selection of features from a video

For a correct implementation of the recognition regions obtained from image segmentation process input video must be represented in a concise form, eliminating redundant information and retaining the necessary information pattern recognition / objects of interest.
Choosing a proper description is essential for the success of the shape recognition process. Also, a fundamental principle which oversees construction shape descriptors is their invariance principle to various types of linear or nonlinear transformations applied form of interest.
The desired invariance of the set of descriptors used at the starting point, scaling, translation, rotation and reflection
Practical experience shows that the most important aspect for the recognition of forms is the selection characteristics / properties or descriptors used.
Selection is a process defining characteristics data compression and can be treated with a linear or nonlinear transformation from space assumed initial observations n-dimensional space with a few dimensions, m (m << n).
Such transformation leads to the preservation of information and enable the development of algorithms in real time, as there are efficient algorithms in terms of computation time and memory resources required only in small spaces.
If a single class of forms, selection of characteristics is considered optimal if the dimensionality reduction achieved with the original information preservation majority.
If there are several classes of shapes, selection efficiency characteristics is given in particular the possibility of separability of classes, which depends mostly on the distribution of classes and selected classifier.

2. Methods and biometric technologies

2.1. Cubic interpolation

Interpolation is a method of estimating the values applied in a location without measurements, based on measured values in neighboring points.
The process consists in finding a function f (x, y) to represent oata surface z values associated with points (x, y) arranged regularly performing a prediction function z values for other positions arranged regularly.
Resiying detected face image as a comparison to the same scale forced test image was performed using cubic interpolation methodology.
This approach assumed predefined approximation techniques based on Spline function.
It was proposed that the application after applying interpolation to achieve:
-Display girl grayscale added intro
- In one text file saving faces involved
In one of thefaces involved -scrierea labels text file for loading and subsequent detection

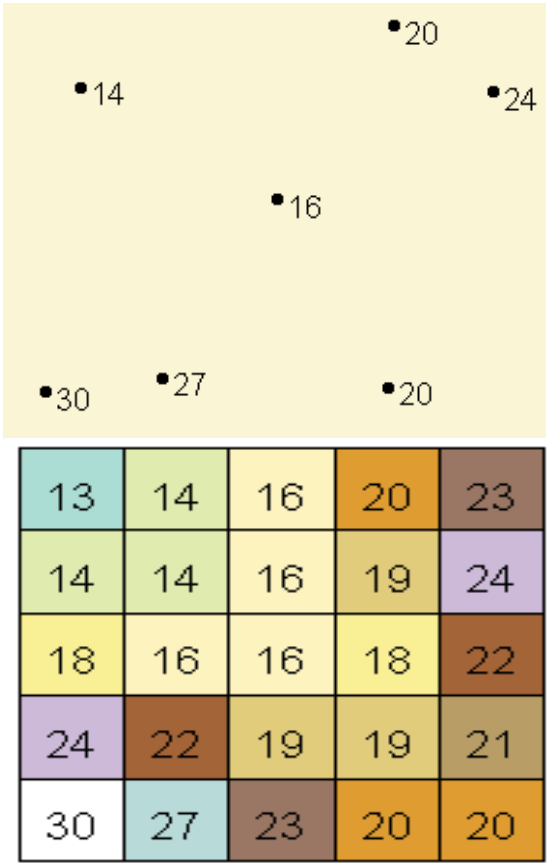

Fig.2.1. Raster resulting from the estimation of known values

Imleplementata graphics on computers must meet the regular appearance, smooth, non-stop, or loop oscillations between measurement points.
To enable interactive design forms, the method requires that a control change position to have a local effect to change the shape curves restricted only in the vicinity of that point.
One of the conditions is described analytical equations of curves to be as simple polynomial form of low, since such a curve will not be able to cover the whole set of defined shape control.
One of the solutions adopted is the separation of the set of control points in subsets of points and the construction of low-level curve for each subgroup. Seeking curve will result in assembling these elementary curves (curve portions) and therefore it will not be described by a single equation on the entire namespace. Smooth curve results will be achieved by imposing continuity and differentiability conditions associated function, the junctions of two portions of the curve.
Constructed in this manner interpolation curve using curve described by polynomial functions of grade 3 natural cubic spline curve is obtained. The downside of this is that you exercise overall control every control on the curve.
Determination of the curve with n + 1 control points require solving a linear system of equations 4 * 4 * n n unknown [9].
This system provides the coefficients of the polynomial functions of grade 3 associated with the n portions defining curve interpolation curve.
Another way to build a cubic spline interpolation curve using a set of splines BASIC. Interpolation curve is obtained as a linear combination (weighted sum) of them. In this case we obtain an interpolation curve on which each checkpoint exert global influence [9].
Providing local control on cubic spline interpolation can be achieved only by giving up some conditions on the curve.

Ditching the requirement that curve to pass through checkpoints leads to obtaining approximation curves B-spline called CURVES (Figure 2.2.). For this type of curve representation using a parametric form.
Given n + 1 control points P0, ..., Pn, we divide the interval [0, n] of the parameter u in n subintervals [ui, ui + 1] with 0 <= t <= 1 and t (0) = ui and t (1) = ui + 1. For each subinterval we, in the expression matrix:

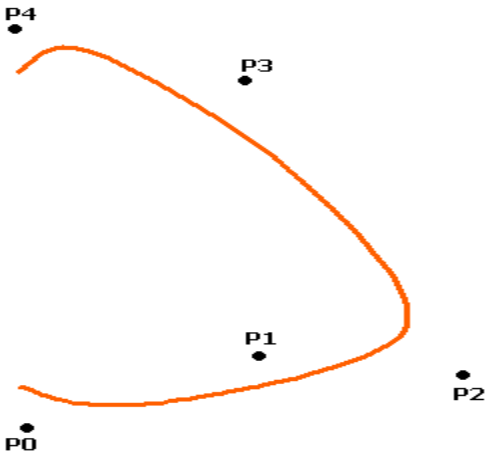

Figure 2.2. Graphical representation of cubic spline function

2.2. Methods for the selection of characteristics
Space dimension characteristics influence the efficiency and performance in large measure classification algorithms.
Thus, a number of classification algorithms effective in areas with few dimensions are impractical in areas with more dimensions.
Therefore we sought to implement changes to prioritize the importance of characteristics and allow transformed space thus reducing its size by removing the least significant, while retaining the essential information for classification.

For this we have selected those features that contain the greatest amount of information on that form.
Applying transformations on the data obtained from the feature extraction phase and retaining only the significant characteristics is called selection (feature selection).
2.3. Principal components analysis (PCA)
Principal components analysis is a standard method of data analysis that enables the detection of the most prominent trends in a set of data.
Let X be a cloud of spatial data ^ n. The main components of Aces sets are directions of ^ n over which the cloud is the most significant elongation. Knowing these directions can serve both purposes of classification and to determine the most important characteristics of point cloud analysis.
PCA reduces the number of variables that the size of a data set.

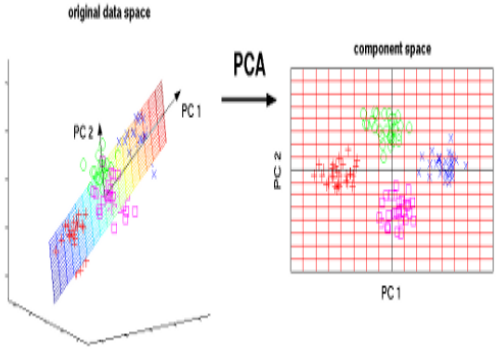

Fig. 2.3. Variant projection representation using PCA

The figure shows a network in a two-dimensional subspace. PCA is used to view the data by reducing the dimensionality of the data. The three variables are reduced to a smaller number, two new variables called principal components (PC). Using PCA, we can identify two-dimensional plane which best describes the varied data.
Space using PCA rotating selection of original data that the axes of the new terms have the largest variation of data in a certain direction. Axes and new variables are called principal components are ordered and variation. The first component, PC 1 is the direction with the largest variance of the data. PC Division 2 is the largest variance that remained after the first orthogonal component. The representation allows to obtain the required number of components that covers a space and the desired amount of variance.
Most transformations used to select characteristics are linear, nonlinear transformations while having a higher complexity, are more difficult to implement, but may have a higher efficiency, better expressing the dependence of the forms observed raw data observed characteristics Selected these forms.
Karhunen-Loeve transform (Principal Component Analysis PCA) is a method of selecting linear characteristics. Let X be an n-dimensional random vector. Looking for an orthogonal transformation enabling optimal representation of the vector X with respect to the minimum mean square error criterion. Projecting cloud directions given by its main components, the immediate effect is a compression of the information contained in that crowd.
According to reference [2], the determination of the main components of cloud data X is reduced to determining the values of vector / matrix eigenvalues of dispersion of a set of data analyzed. Linear nature of the standard PCA method (performed by linear projection data analyzed components / main directions) causes a number of serious shortcomings in the actual processing of the input data.
Accordingly, the present have been developed a series of nonlinear generalizations of the classical variant, an example being Kernel PCA algorithm whose structure is shown in [1].
In EigenObjectRecognizer.cs found in Appendix source code used for each object recognition method PCA (Principal Components Analysis).

2.4. Estimated threshold segmentation

The evaluation method was to estimate the position of the subject by determining the center of the image divided by targeting the optimal threshold [13] .Segmentarea original image was taken with the optimal threshold that applies a centroid algorithm.
Complex texture and contrast of the image segmentation and reduced the occurrence of residues.
Filtering solution was used and a calibration algorithm centroid discrimination threshold of the subject [20].
The following algorithm is shown schematically described.

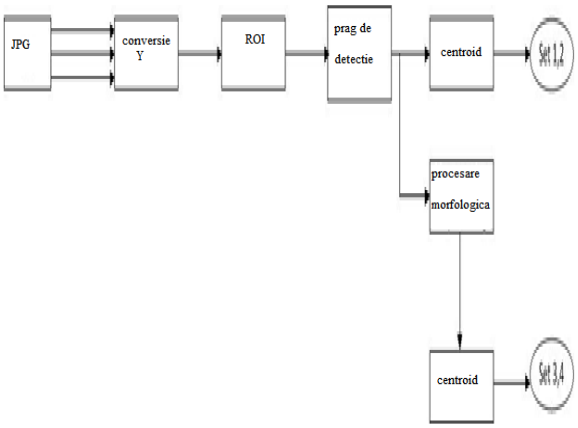

Fig.2.5. The structure of the proposed algorithm

The original image was made on the optimal threshold segmentation applying a centroid algorithm. Complex texture image and low contrast led to the emergence of segmentation artifacts whose elimination was chosen solution applying a morphological filter.

2.5. Viola-Jones algorithm

I LIKE HAAR cascade classifiers inserted the model next model, applying these classifiers in order to run out and get a face in the image analyzed.
The method allows to be used and if a classifier has elements of validity.
Viola Jones algorithm provides results with accuracy of up to 95% for the detection of human face, implying only 200 simple classifiers.
Processing can be done using a medium-performance computer installed with a 2GHz processor that can process such approx. 5 frames per second images.

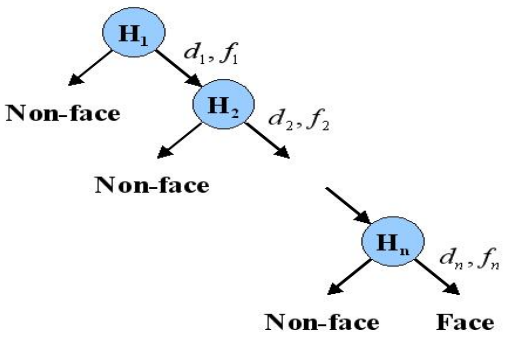

Fig.2.6. Viola-Jones algorithm schematics

Specific algorithm used in the application is using centroid detection face having the structure of Figure 2.5. and is described by the equations of fig.2.1., where S is the threshold used to discriminate pupil

$$X = \sum_{j=1}^{m}\sum_{i=1}^{n}\mu_{ij}x_i \Big/ \sum_{j=1}^{m}\sum_{i=1}^{n}\mu_{ij}, \quad Y = \sum_{j=1}^{m}\sum_{i=1}^{n}\mu_{ij}y_i \Big/ \sum_{j=1}^{m}\sum_{i=1}^{n}\mu_{ij}$$

$$\mu_{ij} = -\mu_{ji} = \begin{cases} 0, & pentru \quad 0 \le \mu < S \\ 1, & pentru \quad S \le \mu < 255 \end{cases}, \qquad (2.1.)$$

Fig.2.8.2. Centroid algorithm implemented to determine the center of the image

2.6. Fusion color space

Color fusion fusion is performed at the combination of raw data. RGB colors merges belonging to the same class as a data vector. Follow transformations PCA feature extraction and classification to obtain decisions.

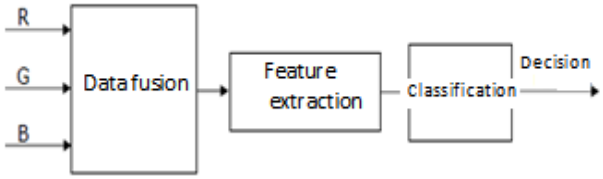

Figure 2.7. Block diagram of classification of color images using RGB color fusion

2.7. Reading images

Database used are specific algorithm. The process envisioned involves first part of the algorithm, the actual completion and processing of test images in the database defaults. Follow extracting feature vectors to be used later in the drive. Set the file path from which it starts going through the contents of each file. It will go through all the images, each image will be read and loaded into a variable.
This process will occur for each file that contains images.
5/49 size image 552 containing 90x120 pixels, a part of which is shown in Figure 1.2.
For video broadcasts once the most important consequence of rapid coverage property is the possibility of adapting the transmission rate flexible image content with a very low rate for another scene or part of the image widest accurate time, if movement.

Figure 2.8. Selection of photos from the database used

The database was made personal and contains a number of 552 photos in JPEG or images of 46 subjects, men and women, young and old, of different ethnicities.
Each subject was asked to simulate many emotions that were tagged in the database xyJPEG form or photographic subject number and position where it was photographed.
Database reflect variations in facial expressions of the subjects as normal / neutral, happy, sad and their intermediate states.
The subjects were photographed in these positions, numbered:
1.normal, front, eyes open;
2.Normal, front, eyes closed;
3.Normal, side, facing left, looking forward, eyes open;
4.Normal, side, facing left, looking forward, eyes open;
5.Happy, smiling;
6.Gloomy;
7. Surprised;
8.Loathing, disgust;
9.Frowning;
10.With glasses;
11.With cap, hat, scarf (head covering);
12.With glasses and head coverings.

The database was divided into 2 parts: training and test.
Each subject has 3 of the 46 images of the test drive and 3, which have been shown to 3i / 3t in the report.
The photographs were taken on in normal lighting conditions, pale uniform background with a camera type Samsung WB 100 without linear filter.
Shots were transposed in format 90x120 pixels (horizontal x vertical) using Photo Paint, achieving a total of 552 photos.

3. Description of application

3.1. Application Architecture

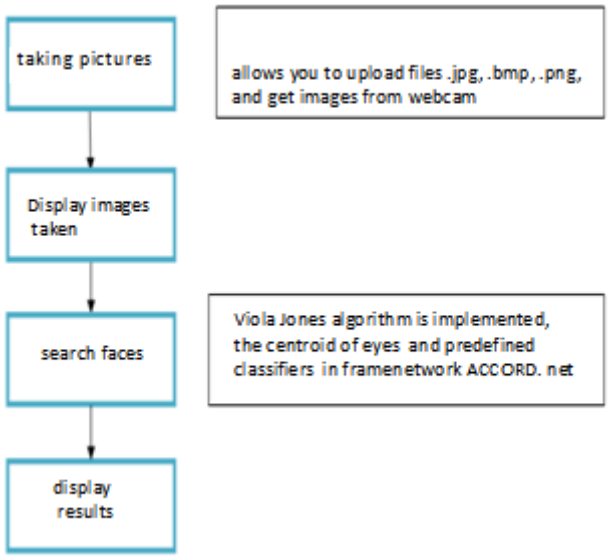

Fig. 3.4. Block diagram of the application architecture

3.2. Details used in the implementation

• classifiers working on subimages with 24 * 24 pixels using only one of the 3 color channels (RGB).
• The detection is done by moving over the image classifiers and classifiers scaling with a step of 1.25.
• I used a ready network involved: haarcascade_frontalface_alt.xml.
• I wrote the source code in C # based on ACCORD's framework. NET.

3.3. Face Detection person

Next Catches capture a person's face recognition extracted from a specific background plenty busy.
Image acquisition is done with a simple web camera without performance.

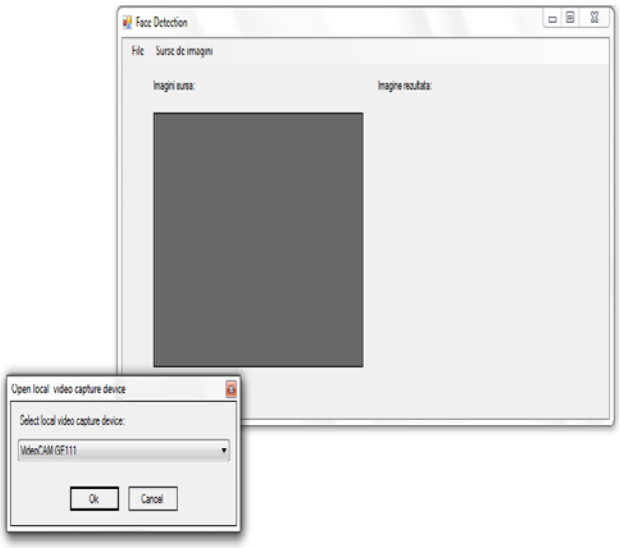

Fig.3. 1. Interface using video images acquired from a webcam

The application was made from library HAAR classifiers implemented using cubic interpolation technology through predefined functions dumps.
The program runs independently and requires the installation of Microsoft Visual Studio 2013 (free), being realiyat in C Sharp programming language.
Main considerations underlying its choice was faorte fast processing speed, the real-time and accessible menu operation / programming.
Programming steps:
1. Declare all variables, objects and image vectors
Image <BGR, Byte> currentFrame; // ** The current facial image
Capture grabber; // ** Variable that stores the captured image
HaarCascade do; // ** Classifier for facial
HaarCascade eye; // ** Classifier for eye
-definition Type font
MCvFont font = new MCvFont (FONT.CV_FONT_HERSHEY_TRIPLEX, 0.5d, 0.5d); // ** Font type and size that will be displayed over the image
-definition images after detection results and therefore to be registered in the database
Image <Gray, byte> result, TrainedFace = null; // ** Resulting image and the image to be captured and recorded in the database
Image <Gray, byte> gray = null; // ** Are stored gray differences of imaginiii
-generate a vector with all imgaginile added
List <Image <Gray, byte >> trainingImages = new List <Image <Gray, byte >> (); // ** A vector with all images (subjects) which will be added to the database
-generate a vector labeling subjects
List <string> labels = new List <string> (); // ** Vector for labeling people
List <string> NamePersons = new List <string> (); // ** Vector of names of persons
int ContTrain, NumLabels, t; // ** Counters for the number of people to be saved (ContTrain) Label (NumLabels) for each detected face proceed to the next step (t)
string name, names = null; // ** Variable of type string (string) to save the name and the names of individuals.

2. Charging classifier for face detection and eye front type Haar Cascade
// ** Loading classifier for face detection front
face = new HaarCascade ("haarcascade_frontalface_default.xml");
// Eye = new HaarCascade ("haarcascade_eye.xml");

-load existing faces and labeling each of them
- Defining messages from box: There is nothing saved (binary) database, please add at least one subject with facial features "," Loading faces and their involvement ", MessageBoxButtons.OK, MessageBoxIcon.Exclamation);
- Capture initialization room (open room)
- Initialization counter drivefaces
- Getting a gray frame capture device (camera)
- Initialization detector Emgu facial image processing
3. Define the action for each element detected
4. Resize for detected face image as a comparison to the same scale forced test image using cubic interpolation.
-Display girl grayscale added intro
- In one text file savingfaces involved
In one of thefaces involved -scrierea labels text file for loading and subsequent detection
-predefine message box "was detected and added." "The training was completed successfully", "activating detection face first." "The training has failed."
5. We obtain the current capture device
- Convert to grayscale image obtained
-Using facial detector MCvAvgComp define actions for each element resulting from classification by drawing HAAR (representation) face detected in slot 0 of gray color using the color blue.
-the appeal to Class TermCriteria that uses image recognition driven with a maximum drive (variable maxIteration).
-the object defines common facial recognition vector
-trasam one label for each face detected and recognized.
- Determine the number of detected faces in scene
-Set ROI face
- Persons whose names are concatenated and posting
6. Displayingfaces processed and recognized
- Release list (vector) name

4. Specifications of the software

The application can be accessed from C: \ Users \ boss \ Desktop \ FaceRecProOV \ bin \ Debug
In C: \ Users \ boss \ Desktop \ FaceRecProOV \ bin \ Debug \ TrainedFaces resulting images are found after the detection and to be registered in the database
In EigenObjectRecognizer.cs found the source code used for each object recognition method PCA (Principal Components Analysis)
In Main Form.cs found in Appendix entire application source code
In Resources are provided opportunities to insert images / database .gif
The app works very well for these resources: 2x dual core processor 2.4Gz,
Ram 2 G. A good quality of images acquired using a web camera depends on quality.
Lighting conditions that were conducted experiments show that this is not critical, but higher recognition performance can be obtained with good illumination of the subject.
Detection and recognition of them involve the acquisition of images, which in terms of technical military requires action ex. access control points have specially designated areas.

4.1. Results

In the research we conducted several experiments:
1.I introduced and analyzed 552 images acquired with webcam (12 images/46 subjects)
2. I have introduced two photos personal database.
It noted that the application can recognize people's faces in photos, provided their prior labeling (police actions)
Detection and recognition of persons in military systems, surveillance objectives / access to these restricted perimeters
Experiments conducted on the sides categories other than human and background objects of different shades, shapes

and sizes showed good selectivity of the human face recognition algorithm AdaBoost.
The application does not create confusion between classes sides and allow a smooth implementation for human face recognition.

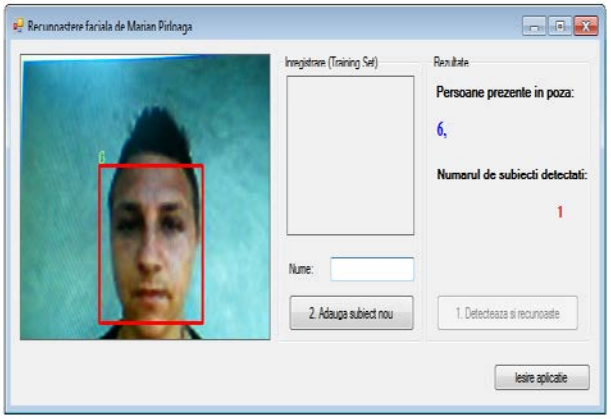

Figure 4.1. Screenshot label a person recognized from the database

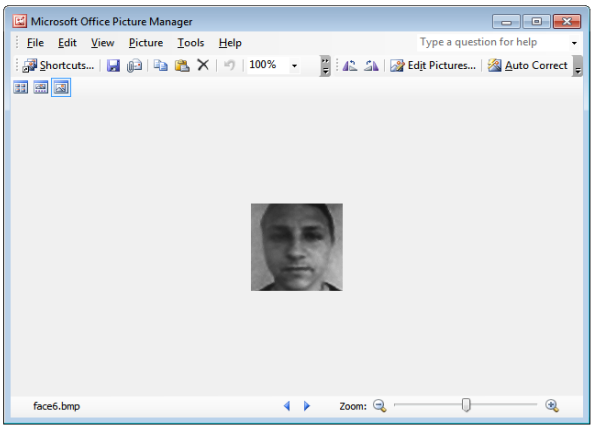

Figure 4.2. Screen capture image data acquired on the basis of the subject no. 6

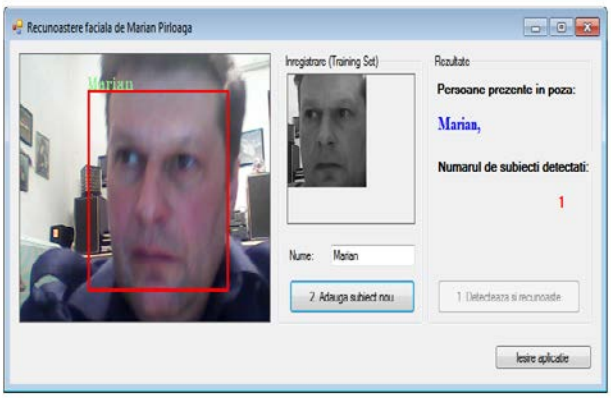

Figure 4.3. Video Image Capture drive name recognized by subject

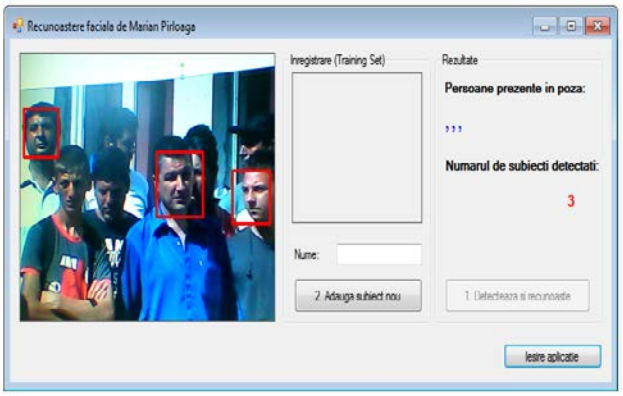

Figure 4.4. Screenshot 3 subjects detected from the database of the busy crowds and their location

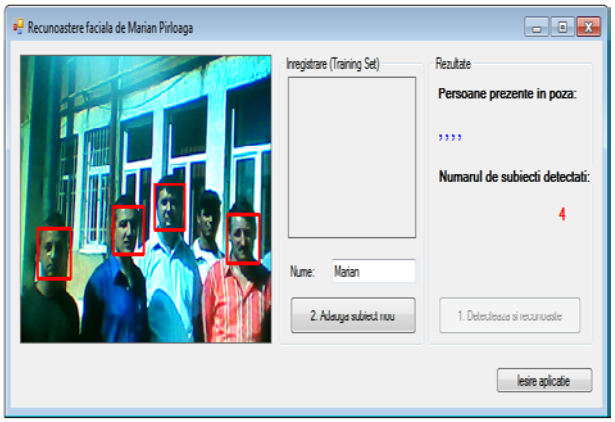

Figure 4.5. Screenshot 4 subjects detected from the database of the busy crowds and their location

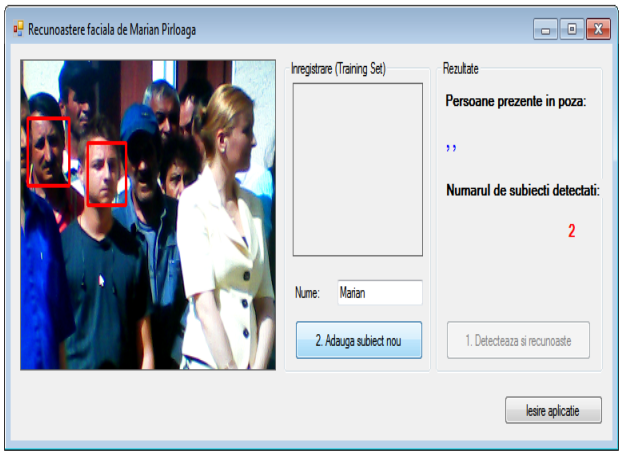

Figure 4.6. Screenshot 2 subjects detected from the database of the busy crowds and their location

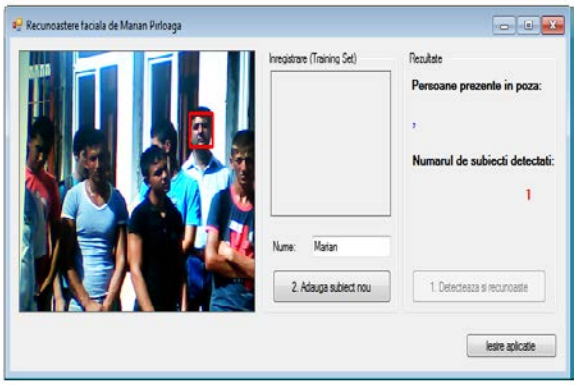

Figure 4.7. Screenshot 1 subject detected from the database of the busy crowds and location of

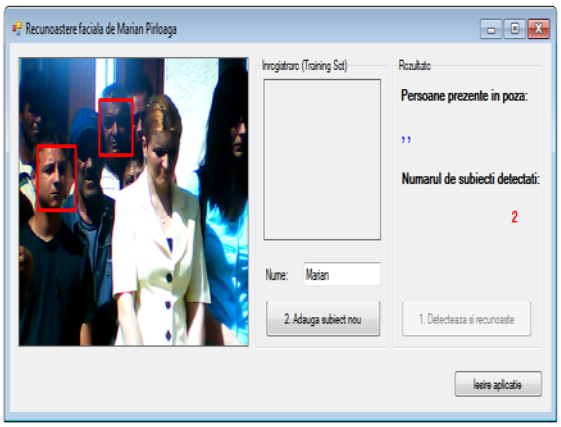

Figure 4.8. Screenshot 2 subjects detected from the database of the busy crowds and their location on the dark background and subject movement

A great contribution made by the software is the recognition of facial emotions simulated by simulating their subject. The application allows the detection of six states such subjects wearing glasses inclusive detection by recognizing facial features and lower their environments.

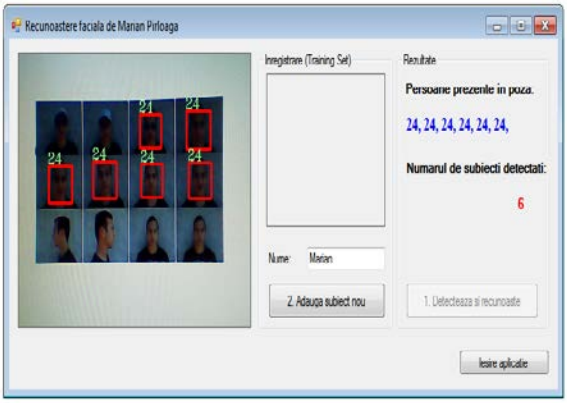

Figure 4.9. Screenshot of subject No. 24 database facial recognized in 6 states: glasses, frowning / angry, sad, surprised, joyful. Light: semi-darkness

Conclusions

1. Method Viola-Jones algorithm and implementing predefined classifiers in the framework ACCORD.NET in a system allowing real time processing.
Recognition rate is over 95% and enables the detection of over 6060 layers.2. The application enables detection using oriented faces higher ungiuri up to 60 degrees from the normal position, the front video image acquisition from other applications that provide results for the orientation of the face to a maximum of 30 degrees to the front position.
3. The results demonstrate that recognition does not create confusion between classes of people, making it a very good separation between data acquisition and processing in humans, animals or objects in the background.
4. detection and face recognition is performed in real time, there are no delays due eg mathematical processing. in Matlab, and superior results are obtained from it.
5. The background of the face recognition that can be observed that it is normal or dark lighting and composition and color varied, those crowded in terms of surrounding objects.
6. The application allows computer processing of images stored as .jpg, .png or .bmp and real-time image provided by a video camera.
7. Comparison and practical results obtained lead to the recommendation of software for military surveillance applications involving detection of people crowded crowds, sporting events, cultural, religious, detection of persons under confinement border or suspicious persons subject to military action pursued or Police.
8. Image processing is a complex and very dynamic, with numerous applications in various military. Further optimization of the application may allow the extraction of useful information from the image and improve the extraction and analysis.
9. The results can track finding algorithm that can perform a parallel search of all images in a database.
10. These data will be used in military applications for the detection of persons subject to the gendarmerie or police missions, as well as those given in the instruction Border crowded crowds.

Personal contributions

1. Conducting two databases with photos and video
2. Achieving applications for detection and recognition of human faces, purchased crowd busy and varied background illumination average to meet the requirements to be implemented on a portable terminal
3. The implementation of robust algorithms and classifiers recognized for their effectiveness in the application of experimental
4. Proposal threshold segmentation method and determination of the image centroid within future research
5. Comparative presentation of the results of experiments and optimization presenting the best results

Performance achieved

1. Achieving recognition of those faces still images in real time
2. Implementation of a portable terminal available for operational applications
3. Getting a recognition rate of 100%
4. The display similarities with other subjects faces database
5. Creating opportunities for implementation in various military applications

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