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Real Time Embedded Implementation of Face Recognition Using Beagle Board

G.Johny[*1], P.Vijay Daniel[2]

[*1]PG Student, Department of Electronics and Instrumentation Engineering, Karunya University, Coimbatore, India

[2] Assistant Professor, Department of Electronics and Instrumentation Engineering, Karunya University, Coimbatore, India

emanuveljohny@gmail.com

Abstract

This Paper presents a Standalone low cost face recognition system. When compared to other bio-metrics systems such as finger print, palm print and Iris, face recognition has distinct advantages because of its non contact process. To secure unauthorized access of the data, this face recognition process will be more secure to develop in future for longer security life. This paper investigates alternative methods to be used for face recognition system by different process. It involves face detection and verification process using Gabor wavelets for huge data sets taken under this method. Then for feature extraction process, we extracted Color-based model, Coarse to fine method, and Gabor wavelets are applied. It has been designed to improve the accuracy of recognition systems in a huge data set, particularly focused on verification of the person rather than identification.

Keywords: Face detection, Coarse to fine method, Face recognition, Gabor wavelet, Beagle board.

Introduction

A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video sequence. We have to compare by selecting facial Features from the image and a database. Few facial recognition algorithm identifies the features by extracting faces or features from an image of the original face. For example, an algorithm may analyze the following features of the relative position, size, resolution and shape of the eyes, nose, cheeks and jaw. The above features mentioned are then used to identify for other images with a stored features of face [2] Many algorithms normalize a gallery of face images and then compress the data, images stored in the data only useful for face recognition. An original image is then compared with the face data.[3] One of the earliest best system[4] is based on template matching techniques[5] applied to a set of salient facial features, It provides a sort of compressed face representation in the stored data. Recognition algorithms are divided into two main approaches geometric, and photometric. Geometric looks at distinguishing features, photometric is a statistical approach that distills an image into values and compares the values with templates to eliminate the variances. Popular recognition algorithms include the most typical Principal Component Analysis (PCA) using Eigen faces, Linear Discriminate Analysis, Elastic Bunch Graph Matching using the Fisher face algorithm, the Hidden Markov model, the Multilinear Subspace Learning using tensor representation and the neuronal motivated dynamic link matching.

Hardware and Software

Beagle board-Xm:

Beagle Board-xM delivers with the help of its AM37x 1GHz ARM processor brings a project to fast development. Designed with community the inputs are in mind to develop this open hardware design brings the previous generation laptop-like performance and expandability to the next level, which improves the power level module growth higher. Direct connectivity is supported by the on-board four-port hub with 10/100 Ethernet.

Processor: AM37x 1GHz ARM Cortex-A8 compatible

More than 2,000 Dhrystone MIPS are used in this board. Up to 20 million polygons/second graphics are modified and High Definition video capable C64+TMDSP core is performing for the resolution. The storage capacity has 512 MB LPDDR RAM inbuilt in this board.

Connectivity

- 2D/3D graphics accelerator
- 4 USB 2.0 ports
- MMC/SD connector
- DVI-D port
- S-Video port
- USB mini AB connector

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- Ethernet

Software Compatibility

- Angstrom Linux
- Android
- Ubuntu
- XBMC

Embedded Linux

The advantages of embedded Linux over proprietary embedded operating systems include multiple suppliers for software development and support, there is no royalties or licensing fee, a stable kernel are ability to read, and also to modify and redistribute the source code. The technical features include a comparatively large memory footprint (kernel and root file system) as a demerit; complexities of user mode and kernel mode memory access; and a complex device drivers framework.[1]

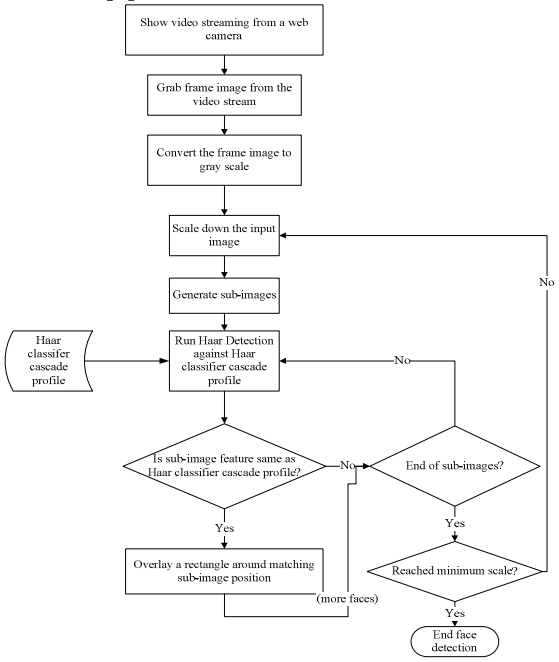

Figure 1: Flow Chart for recognition process

Block Diagram

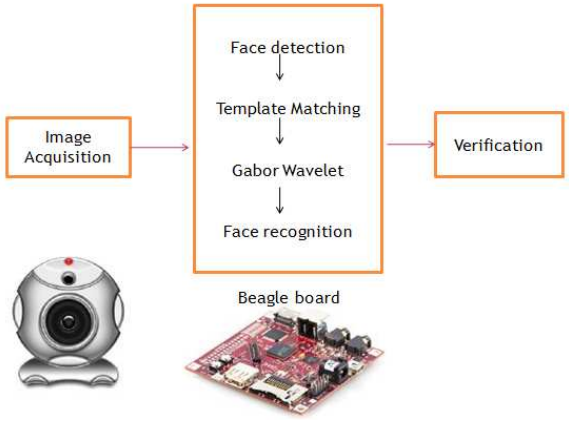

Figure 2: Block diagram representation

Explanation

An input image or video captured by the USB cam for image acquisition process. After completion of image extraction the feature extraction process will start, this process undergoes coarse fine method for skin detection, then color based model for edge detection, after the completion of these process Gabor wavelets are applied to those methods which are occur inside the board, as mentioned in the figure 2, then it will featured by Haar classifier. The input images are stored in a set of data-base for the image retrieval, when the image gets matching.

Feature Extraction

For this analysis we are extracting some features based on the methods which framed on the figure 3.

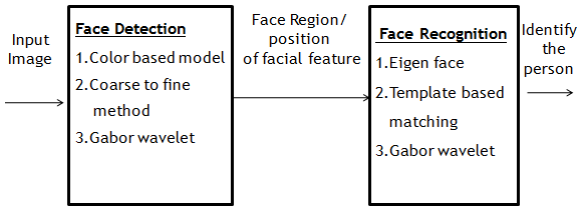

Figure 3: Frame work of the process

Color based model:

In three-dimensional Euclidean space if one identifies the x, y, and z axis with the stimulus for the large-wavelength (L), medium-wavelength (M), and short-wavelength (S) light receptors. The representation of origin, (S,M,L) = (0,0,0), corresponds to black which has no definite position, rather it is defined according to the color temperature or white balance as desired or as available from the original ambient lighting. The human color space has a structure of horse-shoe-shaped cone, extending from the origin to the infinity. In practice, the human color shown will be saturated or even be damaged

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at extremely high light intensities, but such behavior is not part of the color space and neither is the changing color perception at low light levels (see: Kruith of curve).The most saturated colors are located at the outer portion of the region, remaining brighter colors farther removed from the origin. In the medium as long as the response of the receptors streamed in the eye are concerned, there is no such thing as "brown" or "gray" light to develop. The new color names which refer to orange and white light respectively, with an intensity that is much lower than the light from surrounding portions. If we can observe this by watching the screen of an overhead projector during a meeting: one sees black lettering on a white background, even though the "black" has in fact not become darker than the white screen on which it is projected before the projector was turned on. The "black" areas have not actually become darker but appear "black" relative to the higher intensity "white" projected onto the screen around it. See also color constancy.The human tristimulus space has the property that additive mixing of colors corresponds to the adding of vectors in this space. This makes it easy to describe the possible colors that can be constructed from the various available colors such as red, green and blue which indicates primarily in a computer display.

Coarse to fine method:

Granularity is the extent to which a system is broken down into small parts, either the system will describe or observed. It is the extent to which a larger entity subdivided into many grains followed by broken parts. For example, In a yard broken convert of inches has finer granularity than it will be broken into feet. The Coarse-grained systems consist of the fewer or larger components than fine-grained systems; a coarse-grained description of a system regards large subcomponents while a fine-grained description regards smaller components of which the larger ones are composed. The terms granularity, coarse and fine are relatively used when comparing systems or descriptions of systems.The terms fine and coarse are used consistently across the fields, but the term granularity is not mentioned with itself. For example, During investing more granularity refers to more positions of small or large size, while photographic film that is more granular and it has few larger chemical "grains".

Gabor Wavelet:

In image processing, Gabor filter is a linear filter used for edge detection. The Frequency and orientation representations of Gabor filters are similar to those of the human visual system have been found to be particularly appropriate for texture representation and discrimination. In the spatial domain, a two dimensional Gabor filter is a Gaussian kernel function modulated by a sinusoidal wave.J.G.Daugman discovered that simple cells in the visual cortex of mammalian brains can be modeled by Gabor functions.[1] Thus, image analysis section by the Gabor functions is similar to perception in the human visual system.ts impulse response is defined by a sinusoidal wave (a plane wave for 2D Gabor filters) multiplied by a Gaussian function [2] Because of the convolution property used in the transformation, the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function. These filter has a real and an imaginary components which represents the orthogonal directions.[3] The formation of two components may be in a complex number or it is used in a individual manner.

Complex

$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma)=\exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\exp\left(i\left(2\pi\frac{x'}{\lambda}+\psi\right)\right)$$

Real

$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma)-\exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\cos\left(2\pi\frac{x'}{\lambda}+\psi\right)$$

Imaginary

$$g(x,y;\lambda,\theta,\psi,\sigma,\gamma)=\exp\left(-\frac{x'^2+\gamma^2y'^2}{2\sigma^2}\right)\sin\left(2\pi\frac{x'}{\lambda}+\psi\right)$$

Where

$x'=x\cos\theta+y\sin\theta$and $y'=-x\sin\theta-y\cos\theta$

In the above equations, both real and imaginary part represents the wavelength of the sinusoidal factor, also it represents the orientation of the normal to the parallel stripes of a Gabor function, it is the phase offset, sigma of the Gaussian envelope and spatial aspect ratio, which specifies the ellipticity of the support of the Gabor function.

Implementation

Edge detection

In the ideal case, the result of applying an edge detector to an image may lead to a set of connected curves that indicate the boundaries of objects, surface markings as well as curves that correspond to discontinuities in surface orientation during the detection. Thus we have to apply an edge detection algorithm to an image may significantly reduce the amount of data to be processed and may therefore filter out information that may be regarded as less relevant, On account of preserving the important structural properties of an image. If the edge detection process stage is successful, the next step has the subsequent task of interpreting the information contents in the original image may therefore be substantially simplified. However that detection is not always possible to obtain such ideal edges from real life images of moderate complexity. By the segmentation process the detection

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marks the outer surface of an image for to perform the action in a verified manner. When compare these along with the wavelets, the result will be shine in the figure 4.

Figure 4: Edge detection of an image

Adaptive skin detection:

The edges extracted from a two-dimensional image of a three-dimensional image or scene can be classified as either viewpoint dependent or independent extracted. Also a another viewpoint independent edge typically reflects inherent properties of the three-dimensional objects, it involves other properties such as surface markings, coarse fine method and surface shape. An edge viewpoint dependent has may change as the viewpoint changes, and it will typically reflects the geometry of the scene in an image, such as objects occluding one another throughout the scene.A typical edge might for instance be the border between a block of red color and a block of yellow. When adding contrast a line (as can be extracted by a ridge detector) can be a small number of pixels have different color on an unchanging background. For a line, there may be one edge indication on each side of the line will be occur.

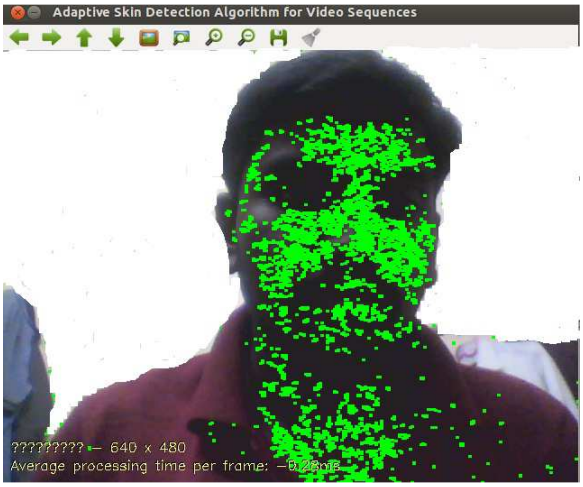

Figure 5:Skin detection of an image

Template matching:

If the template image has strong features, then a feature-based approach may be considered for that method; and also the approach may prove further useful if the match in the search image might be transformed towards some fashion location. Even this approach does not consider the entirety of the template image during analysis or retrieval, it can be more computationally efficient when working with source images of larger resolution as the alternative approach, template-based method may require searching potentially in larger amounts of points in order to determine the best matching location.[5]

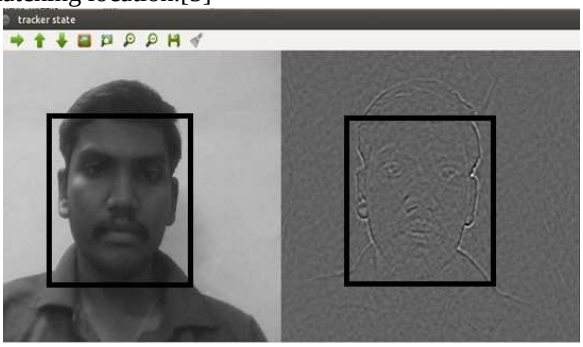

Figure 6: Template matching process

Result

The Face Detection system provides a solution for automatically detect the faces in still images and the real time video feeds of an image. The recognition system can detect an arbitrary number of faces at any scale and location. The system takes photographic images or a video stream as input. The output consists of an array of circles which corresponds to the location, at the scale margin and scale of faces detected. If it detects no faces then it will be return an empty array.

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Figure 7: Face detection of a video sequence

Conclusion and Future Work

This project expanded the application fields for the DM3730 digital signal processor along with chips, meanwhile provided a hardware platform which can be more rapid developed an application system like face recognition system and iris recognition system. It helps for the high security purpose to avoid secured data access. An improved method based on the Wavelet transform of within-class average face image is presented. Compared with traditional method, it is more reasonable to process samples with same class and different class. Therefore a higher correct detection rate can be acquired and a better efficiency can be achieved.

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