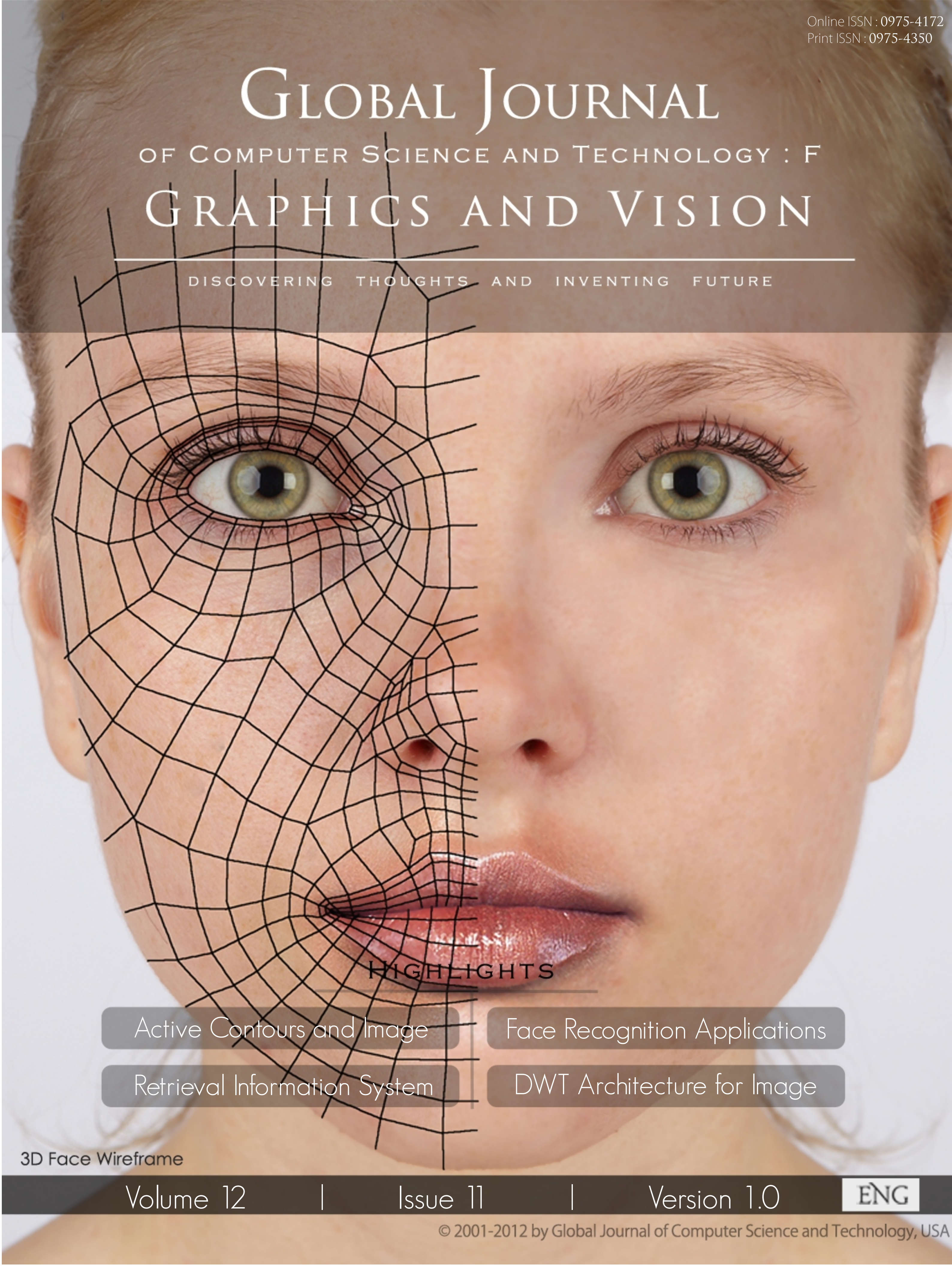

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DISCOVERING THOUGHTS AND INVENTING FUTURE

HIGHLIGHTS

- Active Contours and Image
- Retrieval Information System
- Face Recognition Applications
- DWT Architecture for Image

3D Face Wireframe

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Active Contours and Image Segmentation: The Current State of the Art

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Keywords : Active Contours, Snakes, Level Sets.

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ACTIVE CONTOURS AND IMAGE SEGMENTATION THE CURRENT STATE OF THE ART

Strictly as per the compliance and regulations of:

Active Contours and Image Segmentation: The Current State of the Art

D. Baswaraj [α], Dr. A. Govardhan [σ] & Dr. P. Premchand [ρ]

Abstract - Image segmentation is a fundamental task in image analysis responsible for partitioning an image into multiple sub-regions based on a desired feature. Active contours have been widely used as attractive image segmentation methods because they always produce sub-regions with continuous boundaries, while the kernel-based edge detection methods, e.g. Sobel edge detectors, often produce discontinuous boundaries. The use of level set theory has provided more flexibility and convenience in the implementation of active contours. However, traditional edge-based active contour models have been applicable to only relatively simple images whose sub-regions are uniform without internal edges. Here in this paper we attempt to brief the taxonomy and current state of the art in Image segmentation and usage of Active Contours.

Keywords : Active Contours, Snakes, Level Sets.

I. Introduction

In most image study operations, example classifiers need individual objects to be divided from the image, so the explanation of those objects can be transformed into a proper structure for computer processing. Image segmentation is a basic task, responsible for the separating process. The function of segmentation is to dividing an image into its basic and disjoint sub-regions, which are identical according to their property, e.g. intensity, color, and quality. Segmentation algorithms are usually based on either discontinuity with sub regions, i.e. edges, or equality within a sub-region, though there are a few segmentation algorithms depends on both discontinuity and equality.

The difference between image segmentation and sample classification is often not clear. The purpose of segmentation is simply to divide an image into several sub-regions, while the role of sample classification is to identify the partitioned sub-regions. Thus, segmentation and sample classification generally functions as individual and sequential process as shown in table 1.1.

However, they might work as an integrated procedure as shown in table 1.2 depending on the image study problem and the performance of the segmentation process. In both way, segmentation significantly affects the outcome of pattern classification, and frequently determines the ultimate success or failure of the image analysis. Since segmentation is an essential job in image analysis, it is involved in mainly image analysis applications, mostly those connected to pattern classification, e.g. medical imaging, remote sensing, security surveillance, military object detection. The stage to which segmentations carried depends on the difficulty being solved. That is, segmentation should end when the region of interest (ROI) in the function have been isolated. Due to this property of trouble dependence, independent segmentation is one of the mainly difficult tasks in image study. Noise and mixed pixels cause by the poor resolution of sensor images create the segmentation problem even more complex. In this document, we recommend novel segmentation methods with a variation framework called active contours.

Active contours are connectivity-preserving relaxation [10] methods, valid to the image segmentation problems. Active contours have been used for image segmentation and boundary tracking since the first introduction of snakes by Kass et al. [11]. The fundamental idea is to start with first boundary shapes represented in a type of closed curves, i.e. contours, and iteratively change them by applying shrink/expansion operations according to the constraints of images. Those shrink/expansion operations, called contour evolution, are done by the minimization of an energy function like fixed region-based segmentation methods or by the simulation of a geometric fractional differential equation (PDE) [12].

Table 1.1 : Medical imaging situation 1: an X-ray image of a hand segmentation and pattern classification as sequential and separate actions

Input data: an X-ray image of a hand

1. Segmentation: separate bones from the X-ray image.
   - Supervised method: qualified features or sample data of bones are provided.
   - Unsupervised method: divide bright regions from the background.
   - Result: bones are extracted, but we do not know what kinds of bones they are.
2. Shape description: explain the extracted bones in a form of numerical features
3. Pattern classification: recognize each bone based on the features

Output data: the character of bones, e.g. thumb, index finger, ring finger, etc.

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Table 1.2 : Medical imaging scenario 2: an MR image of a brain. Segmentation and pattern classification as an included procedure

Input data: an MR image of a brain 1. Segmentation & pattern classification: partition white and gray matters in the MR image. • Supervised: trained features or sample data of white and gray Matters are provided. • Unsupervised: partition the brightest regions and brighter regions from the background. **Output data:** extracted white and gray matter.

An benefit of dynamic contours as image segmentation methods is that they dividing an image into sub-regions with continuous boundaries, while the border detectors based on threshold or local filtering, e.g. Canny [13] or Sobel operator, regularly result in irregular boundaries. Apply of level set theory has provided more flexibility and convenience in the completion of active contours. Depending on the implementation method, active contours can use diverse properties used for other segmentation methods such as edges, statistics, and texture. In this paper, the proposed active contour models using the statistical information of image intensity inside a sub-region.

II. Image Segmentation Using Active Contours: The Taxonomy

There are two major approaches in image segmentation: edge- and region- based. Edge based segmentation partitions an image based on discontinuities with sub-regions, while region-based segmentation does the similar function based on the uniformity of a desired property within a sub-region. In this chapter, we briefly discuss existing image segmentation technologies as background.

a) Edge-based Segmentation

Edge-based segmentation looks for discontinuities in the intensity of an image. It is more likely edge detection or boundary detection rather than the exact meaning of image segmentation. An edge can be defined as the border between two regions with relatively separate properties. The assumption of edge-based segmentation is that every sub-region in an image is sufficiently uniform so that the transition between two sub-regions can be determined on the basis of discontinuities alone. When this statement is not valid, region-based segmentation, discussed in the next section, regularly provides more reasonable segmentation outcome. Basically, the idea underlying most edge-detection techniques is the computation of a local derivative operator.

Edge detection by gradient operations usually works well only in the images with sharp intensity transitions and relatively low noise. Due to its sensitivity to noise, various smoothing operation is usually essential as preprocessing, and the smoothing effect consequently blurs the edge information. However, the computational cost is comparatively lower than other segmentation methods because the computation can be complete by a local filtering operation, i.e. convolution of an image with a kernel.

b) Region-based Segmentation

Region-based segmentation looks for equality inside a sub-region, based on a desired property, e.g. intensity, color, and texture. Clustering techniques encountered in pattern classification literature have related objectives and can be applied for image segmentation [14].Region rising [15] is a technique that merges pixels or small sub-regions into a bigger sub region. The simplest implementation of this approach is pixel aggregation [19], which starts with a set of seed points and grows regions from these seeds by appending nearby pixels if they satisfy the given criteria.

Despite the simple character of the algorithm, there are basic problems in region rising: the selection of initial seeds and suitable properties to grow the regions. Selecting initial seeds can be frequently based on the character of applications or images. For example, the ROI is generally brighter than the background in IR images. In this case, choosing bright pixels as initial seeds would be a suitable choice.

Additional criteria that use properties to raise the regions lead area growing into more sophisticated methods, e.g. region competition. Region competition [16, 17] merges neighboring sub-regions under criteria involving the equality of regions or sharpness of boundaries. Strong criteria tend to generate over-segmented results, while weak criteria lean to produce poor segmentation outcome by over-merging the sub-regions with blurry boundaries. An alternative of region rising is split-and-merge [18], which partitions an image firstly into a set of arbitrary, disjointed sub-regions, and then combine and/or split the sub-regions in an attempt to satisfy the segmentation criteria.

c) Active Contours

The method of active contours has become quite popular for a range of applications, mainly image segmentation and motion tracking, through the last decade. This methodology is based upon the use of deformable contours which match to various object shapes and motions. This section provides a theoretical setting of active contours and an indication of existing active contour methods. There are two main approaches in active contours based on the mathematic implementation: snakes and level sets. Snakes explicitly shift predefined snake points based on an energy minimization method, while level set approaches move contours completely as a particular level of a function.

As image segmentation methods, there are two kinds of active contour models according to the force evolving the contours: edge- and region-based. Edge-based active contours apply an edge detector, typically based on the image gradient, to locate the boundaries of sub-regions and to draw the contours to the detected boundaries. Edge-based approaches are closely connected to the edge-based segmentation. Region-based active contours apply the statistical information of image intensity inside each subset instead of searching geometrical boundaries. Region-based approaches are also closely connected to the region-based segmentation.

d) Snakes

The initial model of active contour was proposed by Kass et al. [11] and named snakes suitable to the appearance of contour evolution.

Solving the problem of snakes is to locate the contour C that minimizes the total energy term E with the certain set of weights α, β, and λ. In numerical experiments, a set of snake points residing on the image plane are defined in the first stage, and then the next location of those snake points are determined by the local minimum E. The associated form of those snake points is considered as the contour. Figure 2.1 shows an example of classic snakes [20]. There are about 70 snakes points in the image, and the snake points form a contour around the moth. The snakes points are firstly placed at more distance from the boundary of the object, i.e. the moth. Then, every point moves towards the optimum coordinates, where the energy utility converges to the minimum. The snakes points ultimately stop on the boundary of the object.

The classic snakes give an perfect location of the edges only if the first contour is given sufficiently near the edges because they make use of only the local information along the contour. Estimating a correct position of first contours without prior knowledge is a complex problem. Also, classic snakes cannot detect more than one boundary concurrently because the snakes maintain the equal topology throughout the evolution stage. That is, snakes cannot divide to several boundaries or combine from multiple first contours. Level set theory [12] has given a result for this problem.

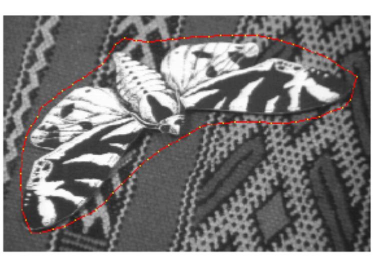

Figure 2.1 : An example of classic snakes

e) Level Set Methods

Level set theory, a formulation to apply active contours, was proposed by Osher and Sethian [12]. They represented a contour implicitly via a two-dimensional Lipschitz - continuous - function $\phi(x,y):\Omega \rightarrow \Re$ defined on the image plane. The function $\phi(x,y)$ is called level set function, and a particular level, generally the zero level, of $\phi(x,y)$ is defined as the contour.

f) Edge-based Active Contours

Edge-based active contours are strongly connected to the edge-based segmentation. Most edge based active contour models consist of two parts: the regularity part, which determines the form of contours, and the edge recognition part, which attracts the contour towards the boundaries. Edge-based active contour models have a little disadvantages compared to the region-based active contour models, discussed in the next section. Because of the constant term, edge-based active contour models evolve the contour towards only one way, each inside or outside. Therefore, an primary contour must be placed completely inside or outside of ROI, and some level of a previous knowledge is still necessary .Also, edge-based active contours inherit a few disadvantages of the edge-based segmentation methods due to the parallel method used. Since both edge-based segmentation and edge-based active contours rely on the image gradient process, edge-based active contours may omit the blurry boundaries, and they are sensitive to local minima or noise as edge-based segmentation does. Gradient vector flow quick geodesic dynamic contours [21, 22] proposed by Paragios replaced the border detection (boundary attraction) word with gradient vector field [23, 24, 25, 26, 27], that refers to a spatial diffusion of the boundary information and guides the propagation to the object boundaries from equally sides, to give extra freedom from the restriction of first contour position.

g) Region-based Active Contours

Most region-based active contour models consist of two parts: the regularity part, which determines the smooth form of contours, and the energy minimization part, which searches for equality of a preferred feature within a subset. A good characteristic of region-based active contours is that the first contours can be situated anyplace in the image as region-based segmentation relies on the global energy minimization rather than local energy minimization. Therefore, less previous knowledge is required than edge-based active contours.

Although usual region-based active contours partition an image into several sub regions, those several regions belong to only two subsets: both the inside or the outside of contours. Chan and Vese proposed multi-phase active contour model [28, 29, 30, 31, 32], which increases the amount of subsets that active contours can locate simultaneously. Multiple active contours evolve independently based on the piecewise-constant model or the piecewise-smooth model, and multiple subsets are defined by a set of disjoint combination of the level set functions.

Due to the global energy minimization; region-based active contours usually do not have any restriction on the placement of first contours. That is, region-based active contour can detect interior boundaries regardless of the position of initial contour.

That is, region-based active contour can detect inner boundaries regardless of the position of initial contours. The use of pre-defined initial contours provides a method of independent segmentation. Also, they are less responsive to local minima or noise than edge-based active contours. However, due to the supposition of uniform image intensity, most methods are relevant only to images where each subset is stand for able by a simple expression, e.g. single Gaussian distribution or a constant. If a subset, i.e. class, consists of multiple distinguishing sub-classes, these methods would produce over-segmented or under-segmented results. We propose novel region-based active contour models which produce better results using multivariate mixture density functions.

h) Active Contours integrating Edge- and Region-based Segmentation

In order to develop the segmentation performance, the integration of edge- and region based information sources using active contours has been proposed by a few authors. Geodesic active region is a supervised active contour model, proposed by Paragios [33, 34, 35], integrating edge- and region-based segmentation module in an energy function. A statistical analysis based on the Minimum Description Length (MDL) measure and the Maximum Likelihood (ML) principle for the observed density function, i.e. an image histogram, indicates the number of sub-regions and the statistical PDF within those sub-regions using a mixture of Gaussian elements. Regional probability is estimated from the statistical PDF based on previous knowledge, i.e. training samples. Then, the margin information is resolute by a probabilistic edge detector, expected from the regional probabilities of neighborhood [36, 37]. For example, an image pixel is more likely an edge pixel if the neighborhood pixels, located on the opposed sides, have high regional probabilities for a different class.

The geodesic active region model is later useful to a medical imaging problem [38, 39] with a gradient vector flow-based boundary factor. The approach was based on a joined propagation of two active contours, and integrates visual information with anatomical constraints.

Jehan-Besson et al. also proposed an active contour model [40, 41] minimizing an energy criterion concerning both region and boundary functional. These functional are consequent through a shape derivative approach as an alternative of classical calculus of variation. They focus on statistical property, i.e. the PDF of the color histogram of a sub-region. Active contours are propagated minimizing the distance between two histograms for corresponding or tracking purposes.

III. Current State Of the Art

In order to overcome the difficulties caused by various intensity in Image segmentation, Chunming Li et al[1] proposed a region-based active contour model, that draws upon intensity information in local regions at a convenient scale. A data appropriate energy is defined in terms of a contour and two fitting functions that locally estimated the image intensities on the two sides of the contour. This energy is then integrated into a dissimilar level set formulation with a level set regularization term, from which a curve development equation is derived for energy minimization. Due to a kernel function in the data fitting term, intensity information in local regions is extracted to guide the motion of the contour, which thereby enables our model to cope with dissimilar intensity. The Region Scalable Fitting Model consists fallowing phases, which are

- Introduction of nonnegative kernel function with Region-Scalable Fitting Energy. The choice of the kernel function is flexible, as long as it satisfies the above three basic properties. The authors are opted Gaussian kernel. The fitting energy defined in the following. First, considering a weighted mean square error of the estimate of the image intensities outside and inside the contour by the fitting values for x as center point, respectively, the result of the kernel function useful on x and y coordinate difference as weight assigned to intensity at selected y-coordinate. Second, due to the localization property of the kernel function, the contribution of the intensity of y-coordinate to the fitting energy decreases and approaches to zero as y-coordinate point goes away from the center point x. Therefore, the energy is dominated by the intensities of the points in a region of. In particular, the Gaussian kernel decreases considerably to zero as y-coordinate goes away from center point x.
- Implementing Level Set Formulation: In contrast to Level set Formulation[42], to protect the reliability of the level set function , which is necessary for exact calculation and stable level set evolution, here an approach called level set regularization introduced that is part of different level set formulation. In this level set regularization, its gradient flow is used as the level set development equation that attempts to minimize the energy functional.
- Energy Minimization: The proposed model is using standard gradient descent (or steepest descent) method to minimize the energy functional.
- Fitting Functions and Level Set Function regularization: The two fitting functions introduced here are different from the data fitting functions

observed in the PS model. This difference is due to the different natures of the data fitting energy terms in the two models. Here in this model the regularity of the level set function is naturally ensured by the level set regularization term in level set formulation described above. This term is related with the fining term as a soft constraint on the regularity of the level set function, which regularizes the developing level set function by fining its departure from a signed distance function, instead of forcing to be a signed distance function.

Observation: Chunming Li et al[1] presented a new region-based active contour model that draws upon intensity information in local regions at a convenient scale to segment images with various intensity, and has advantageous performance for images with weak object limits. To ensure exact computation and avoid expensive repeated initialization procedures in promptness of the level set function, the authors succeed by introducing the level set regularization term in the proposed level set formulation.

In the research area of multi agent IVUS image segmentation, **Bovenkamp et al [2]** introduced a novel User-Agent Cooperation methodology, which initiated the expert communication with a multi-agent image interpretation system using only a limited vocabulary of high-level user communications. The aim is to minimize the influence of expert's views those encouraging the variations in image segmentation. This model is attempting to do this by keeping the total number of communications as low and simple as possible. The multi-agent image interpretation system has complicated high-level knowledge-based control over low-level image segmentation algorithms. The user, in turn, can correct, supplement, and/or confirm the results of image-processing agents. High-level communication thereby replaces more conventional contour correction methods like inserting points and/or (re)drawing contours. The system has been applied to intravascular ultrasound (IVUS) images.

Here in this model proposed by Bovenkamp et al[2], agents use the moving-average of the cross-sectional lumen and vessel area to estimate when user communication is required. When a newly found result is within limits of this moving-average, the new result is unspecified to be ok, and the user is not consulted. Otherwise the user is asked to confirm that a result is not-ok and should, for instance, actually be much-larger. The terms ok, not-ok, and much-larger are instances of the formalized and high-level communication vocabulary between agents and user. Possible agent–user communications in differing situations are listed in Table I, while Table II lists agent–user communications when image-processing results are not trusted or need to be quantified.

Question	User Choice	Result
Object?	Ok	Agent assumes the object is detected correctly, other agent has retracts opinion, conflict resolved.
	Not-ok	Agent retracts opinion, other agent retains opinion, conflict resolved.
No-Object?	Ok	Agent assumes there is no object, other agent has to retracts opinion, conflict resolved.
	Not-ok	Agent retracts opinion, other agent retains opinion, conflict resolved.

Table I : Agent-User Interaction, initiated when a mutual conflict cannot be resolved

User Choice	Specification	Result
ok	judge:(very) (very)small, (very) (very)large, average	Agent accept object and sets object quantification to user choice.
not-ok	steer:(much) (much)smaller, (much) (much)larger	Agent adjusts image processing parameters and retries detection, result not guaranteed, agents re-enter evaluation loop.
Remove-object		Agent removes object and notifies others.
is-other object	Calcified_plaque, deep_Calcified_plaque, stent, shadow, side branch	Agent transfers object to other agent.

Table II : Agent-User Interaction, initiated when an agent need user input during evaluation of image processing result

The tables show which choices can be presented to the user by the agent and list the possible specifications of each choice as well as the result it will have on the agent.

Observation: Bovenkamp et al[2] aimed to found whether it is possible to get more accurate, reproducible results in an professional manner with only a limited set of high-level user communications. And also aimed to introduce agents those regularly adjust their behavior by learning from these communications such that less user interference may be necessary. As a result it was observed that this leads to minimal variations due to expert's role in segmentation and increased ability of repeats and effectiveness. It has been shown that with only high-level user communication in a multi-agent IVUS image segmentation system it is possible to obtain results which are at the least competitive with a committed semi-automatic system with low-level user communication. With comparatively few (2–3) high-level

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user communications per improvement, multi-agent IVUS image segmentation can significantly be improved, while the user is initiating corrective actions in only about 43% (255 versus 594) of the cases when compared with the committed semi-automatic system. No image processing or agent knowledge is required of the user to correct image segmentation results. Experiments show that even when images are very difficult to segment, aggressive results can be obtained in this fashion. However, although enough for most cases limited control by the user over the segmentation process (only very high level) was sometimes too preventive to get to the desired result and is a source of observer errors.

Srinivasa, G et al [3] proposed an active mask algorithm for the segmentation of fluorescence microscope images of punctate patterns. In order to develop this algorithm, Srinivasa, G et al [3] considered active-contour methods for their flexibility, multi resolution methods due to their magnitude speed, multiscale methods by considering their efficiency in smoothing, and region-growing methods for their statistical modeling. The framework developed as top layer of the algorithm proposed moves from the idea of the ldquo contour rdquo to that of ldquo inside and outside, rdquo or masks, allowing for easy multidimensional segmentation. The framework was aimed to adapt the topology of the image through the use of several masks. To claim the benefit of the algorithm proposed, Srinivasa, G et al [3] argued that since a fluorescent microscope images the cells by revealing the specimen with light of a specific wavelength, exciting the fluorescent probes to emit light of a longer wavelength; a CCD camera records photon emissions resultant in a digital image. As only some parts of the sample are tagged and the tagging is not uniform, the resulting image looks like a allocation of bright dots on a dark background, a punctate pattern. Hence they focused on images in which such patterns represent individual cells in a multi cell specimen.

The algorithm is almost invariant under initialization, allowing for random initialization, and uses a few easily tunable parameters. Experiments show that the active mask algorithm matches the ground truth well and outperforms the algorithm widely used in fluorescence microscopy, seeded watershed, both qualitatively, as well as quantitatively.

With issues rose in order to segment fluorescence microscope images such as

- Difficulty in identifying the contour in a digital images
- Updating the level set function in active-contour algorithms, which is ineffective and slow.
- Difficulty in reconstructing the level set function in the multi resolution version?
- Difficulty in protect topology during Updating in large increments in the multiscale version.

Observation: Srinivasa, G et al [3] worked on fluorescence microscope images of punctate patterns, and assume that: (a) the statistical properties of the foreground (cell) and background are distinct and relatively uniform; (b) the foreground is bright, while the background is dark. The first assumption is crucial, the second not at all; one can easily change the algorithm should the position be reversed in another modality (such as bright field microscopy). Thus, in this proposal, the authors are basically looking for two different statistical models in the image (foreground and background). We note, however, that the techniques existing here may be generalized to the case of more models. The proposed new algorithm termed as active mask segmentation that designed for segmentation of fluorescence microscope images of punctate patterns, a large class of data. It seems to disappear from the idea of the contour and instead uses that of a mask, as well as several masks. The algorithm easily performs multidimensional segmentation, can be initialized with random seeds, and uses a few easily tunable parameters.

Wenxian Yang et al[4] proposed a constrained random walks algorithm that facilitates the use of three types of user inputs: 1) foreground and background seed input, 2) soft constraint input, and 3) hard constraint input, as well as their combinations. To support the context of their research model Wenxian Yang et al[4] argued that one common fault in the existing interactive image segmentation algorithms is the lack of more intellectual ways to understand the intention of user inputs. The foreground and background seed input of the proposed model is meant to allow a user to draw strokes to specify foreground and background seeds. The soft constraint input is meant to allow a user to draw strokes to point out the region that the boundary should pass through. The hard constraint input meant to allow a user to specify the pixels that the boundary must align with. The proposed method attempted to support all three types of user inputs in one logical computational framework consisting of a constrained random walks and a local editing algorithm, which would allow more accurate contour refinement.

This proposed model formulates the segmentation problem on a graph, where each node represents a pixel and neighboring nodes are linked with undirected edges. In particular, a graph is represented by its vertices and edges also integrate two other types of user inputs as constraints into the random walks algorithm. We call such an extension as constrained random walks. In particular, boundary brush strokes that roughly mark parts of the boundary are introduced as the soft constraint. A vertex on which the soft constraint is forced has the property that the difference between its probability and 1/2 is within a small given range (-e, e). The second type of user inputs, boundary pixel selector, which selects pixels on the desired contour, is introduced as the hard constraint. A vertex on which the hard constraint is imposed has a probability of 1/2.

Observation: The proposed model can be summarized as follows. First, the proposed constrained random walks algorithm together with the proposed local editing algorithm supports the three types of user inputs and their combinations in a coherent and unified framework. Second, the region prior term is integrated in the edge weights so that the proposed constrained random walks algorithm does not lose the connectivity property and is less demanding on the positions and quantities of the user input strokes than the original random walks algorithm [43]. Third, the proposed local editing algorithm also allows additional local refinement to reach a satisfactory segmentation.

Ping-Feng Chen et al[5] proposed a novel model to jointly segment and register objects of interest in layered images. Since the Layered images refer to imageries taken from different perspectives and possibly by different sensors, the registration and segmentation are therefore the two main tasks which contribute to the bottom level, data alignment, of the multi sensor data fusion hierarchical structures. In contrast to most exploitation of two layered images those assumed that scanners are at very high altitudes and that only one transformation ties the two images, the proposed model consider the data as taken at mid-range and therefore require segmentation in the process of examining different object regions in a divide-and-conquer fashion. The proposed multiphase joint segmentation by Ping-Feng Chen et al[5] is a combination of multiphase method with a combined segmentation registration practice in short that referred as MPJSR agreed out in a local moving window earlier to a global optimization. To auxiliary address layered video sequence and tracking objects in frame, MPJSR is using a trouble-free adaptation of optical flow calculation along the lively contours in a pair of layered illustration sequences.

The related kind of works introduced former to MPJSR are delineating a intention of interest [44], mosaic king scenes [45], [46], and inclusion data [47]. Techniques which jointly exploit the information from special sensors formally fall within data fusion [48]. Data fusion incorporate a well-established categorization of “fusion levels” that groups different iterative processes of opposed maturity levels. The foundation level, i.e., 0-level of “data alignment” [49], is the preprocessing, registration, and geo-registration of metaphors, which prepares the data for other blend levels. Image registration, which finds the correspondence or the transformation between two images [46], [50]–[56], therefore contributes to this stage in the data fusion hierarchical structure.

Observation: Ping-Feng Chen et al[5] have projected a joint segmentation and register method adapted to multiphase active contours (MPJSR) using a heartrending local window. By first resembling the detected object surface within a window in the basis and the reference images by planes, and then by evolving a m-phase active contour via the proposed joint segmentation- registration technique, The proposed MPJSR would able to 1) delineate an object of interest, 2) obtain the acquired transformations between two images. This method successfully segments and registers a pair of layered images, and moreover allows us to align segmented objects from one image to another, thus, achieving a 0-level data alignment stage in the data fusion hierarchy.

Figueiredo et al[6] proposal expected to introduce a variational image segmentation method for assess the aberrant crypt foci (ACF) in the person colon captured in vivo by endoscopy. The proposed segmentation technique enhanced the active contours without edges model of Chan and Vese to account for the ACF's particular structure. Level sets to represent the segmentation boundaries and discretize in space by finite elements and in (artificial) time by fixed differences are employed. The model proposed by Figueiredo et al[6] aimed to classify the ACF, their boundaries, and some of the internal crypts' orifices. Figueiredo et al[6] suggestion focused on a fussy image processing method, for assess the ACF captured in vivo by endoscopy: image segmentation. This method consists in the dividing wall of the given image into put out of joint regions, representing distinct objects. Moreover, we use image segmentation methods based on partial differential equations, more exactly, active contours without edges (ACWEs) and level-set methods. These combine techniques of curve evolution (where the basic idea is to start with an initial curve in the image and to deform it to the boundaries of the objects in the image, and stop it there, see [57], [58], and [11]), Mumford–Shah functional for image segmentation (an optimization problem to obtain a sliding doors of the given image into different regions, see [59]) and level-set methods (essentially these consist in considering the problem in a higher measurement, such that the evolving curve is the zero level set of an unknown function; these methods allow cusps, corners, and usual topology changes, as merging and breaking curves, see [60], [61], and [62]). We note that the expression “without edges” in “ACWEs” refers to the fact that in these models it is not used any edge-detector function, based on the gradient of the given image, to identify the different objects (the “edges,” in an image, are the boundaries of the distinct objects, corresponding to the places where these objects meet). This latter property allows the model to segment images where there are no clear gradient boundaries, which is often the case for ACF endoscopic images.

Observation: The aid of the model proposed can be refer to enhancements of the Chan and Vese model and to the parallel numerical tests performed with these models to version for the in vivo endoscopic ACF segmentation. More specifically, these main issues are the following.

- A new numerical system for solve the weak difference formulation of the Chan and Vese model is defined. The weak formulation has the help of requiring less functional regularity for the unknown level set function. The numerical scheme involves a finite element discretization in space and implicit finite differences in (artificial) time. It is correspondent to a L–M Newton-type optimization method.
- A new ACWEs model is definite. It relies on the Chan and Vese model, but incorporates additional terms whose goal is to confine specific features of the ACF that are important to clinicians: the anomalous crypts' restrictions stain darker than normal crypt and in general inside each focal point, the crypts' orifices have shapes that are similar to each other.
- The mixed regularize model is based on the Chan and Vese model, but involve an additional regularization term, which penalize deviations of the angle of the level set function from unity, and thus address the heterogeneity of the level-set function for a given shape. This avoids the standard line of periodically reinitializing the level-set function to a signed distance function, and permits the full power of a Newton-type optimization method to be applied to minimization of the objective (since the uniqueness constraint is automatically incorporated).

Optical coherence tomography (OCT) is a noninvasive, depth-resolved imaging modality that has become a high up ophthalmic diagnostic technique. **Yazdanpanah et al[7]** presented a semi-automated segmentation algorithm to detect intra-retinal layers in OCT images acquired from rodent models of retinal degeneration. The proposed segmentation technique was adapted Chan-Vese's energy-minimizing active contours without edges for the OCT images, which in turn suffered from low contrast and were highly tarnished by noise. Hence a multiphase scaffold with a circular shape prior was adopted in order to model the borders of retinal layers and educated guess the shape parameter using least squares. A related scheme was used to balance the weight of poles apart terms in the energy functional.

The objective of the projected segmentation technique is to segment a given OCT image define on the image domain into R disjoint sub-regions, which exactly label the retinal layers. The decomposition of the image I will be modeled using the level set framework as a set of $R-1$ Signed Distance Functions (SDFs), φ. The distance function captures the distance from any point in the image province to the object limit and assigns this distance to that point's location. The SDF assigns opposite signs to the interior versus exterior of the object. Formally, the SDF is an implicit function with positive values in the interior region, negative values in the exterior region, and zero on the boundary with the property that ranges between 0 and 1.

Observation: Earlier to the Yazdanpanah et al[7] proposal, several robotic and semi-automated approaches have been employed in OCT segmentation [63]–[72]. Some method rely on pixel-level edge exposure algorithms [10] or are based on performing a 1-D importance peak detection procedure for each A-scan [64]–[66]. These low-level approaches could potentially lead to the finding of not working restrictions and erroneous edges. Moreover, since OCT images are highly corrupted by speckle noise, these algorithms required preprocessing to reduce the effect of noise. The de-noising procedure, however, affects the sharpness of the edges, which subsequently reduces the segmentation appearance. In [67] and [68], a Support Vector Machine (SVM) algorithm is used to perform segmentation of retinal layers. By deportment in mind the mean intensity of six neighbors at each voxel, the SVM approach can handle noisy OCT images. However, this approach is not only dependent on a user to mark a set of points for the rationale of training and segmentation but also fails to segment the layers accurately if the feature and environment points are not chosen properly. Further, SVM is computationally expensive and is not able to segment all layers at the same time. Garvin et al. [69] and Haeker et al. [70], [71] model the segmentation problem as finding the minimum s–t cut of a geometric graph. The cost function is the summation of an edge-based term and one or more region-based terms. They have developed a sequential approach to segment the intra retinal layers. First, the three easier-to-segment surfaces are found (upper surface of NFL and better and lower surfaces of OS). The position of the previous segmented surface is incorporated into the cost function to explain the remaining surfaces. The problem arises when the preceding surface are segmented inaccurately. This may result in an erroneous segmentation of the remaining surfaces. Recently, Garvin et al. [72] have proposed an extension to their algorithm. By learning the surface feasibility constraints using a training set, they can segment the layers in two stages incorporating both the image edge and true regional information in the cost function. The residential iterative algorithm[7] to segment OCT images of rodent retinal layers using a multi-phase framework with a rounded shape prior attempt to demonstrate that the approach is able to truthfully segment all of the intra-retinal layers, even when the small size and similar texture make them difficult to make a distinction visually. And also this model attempted to show that the inclusion of a shape prior constraint improves show on regions with intensity

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heterogeneity. This proposed segmentation technique backed with a contextual scheme to stability the weight of different terms in the energy functional, which seems to make the algorithm more robust when the image information is not sufficient to accurately detect the layers. This method is a region-based segmentation approach combining the intensity information and the implicit use of edge information, through the shape term, to improve the final segmentation accuracy.

Delu Zeng et al[8] considered the task of object segmentation and achieve in a novel manner that backed by the Poincaré map method in a defined vector field in view of dynamical systems. An interpolated swirl and attract flow (ISAF) vector field is first generated for the observed image. Then, the states on the limit cycles of the ISAF are located by the convergence of Newton-Raphson sequences on the given Poincaré sections. Meanwhile, the periods of limit cycles are determined. Consequently, the objects' boundaries are represented by integral equations with the corresponding converged states and periods.

In this developed model [8], intially an interpolated swirling and attract flow (ISAF) field is generated by extending a so-called edge tangent flow (ETF) only with a nonzero value at the boundaries to the whole image domain. It is a static vector field. Different from traditional vector fields, the components in this vector field near the boundary are not making a corner but tangent to the boundary. Thus, in the proposed vector field, it is possible for evolution to be carried out along the boundaries. Then, the proposed time-invariant vector field is considered as the right-hand-side vector-valued function of an autonomous dynamical system. As a result, the segmentation problem is translated to the problem of the limit cycle location by applying the related theory in dynamical systems. ISAF is composed of two components, namely, diffused ETF (DETF; swirling component) and diffused edge perpendicular flow (DEPF; attracting component). DETF is given by the steady-state solution. However, in DETF, the degree of swirl (rotation) for the streamlines away from the boundary is too high; thus, the journeys are so long for the streamlines start away from the boundary to move to the boundary. In fact, it just need a flow field bearing the properties that its components away from the boundary would point directly to the boundary and its components near the boundary are tangent to the boundary with a fixed direction (either clockwise or counterclockwise). ETF is a thin flow affecting around the objects' boundaries with a fixed direction. It has components with a nonzero vector value near the boundaries and with a zero vector value to another place.

Observation: The object segmentation is achieved in a novel manner by the Poincaré map method in the field of dynamical systems. First, for an observed image, an ISAF vector field is proposed, where there exist to swirling components (with fixed directions) near the object's borders. This is a key feature of the ISAF compared with the traditional vector field utilized in the ACM method. These swirling workings treated as limit cycles in view of dynamical systems correspond to the desired objects. Then, the Poincaré section and the corresponding Poincaré map for the ISAF are defined. Accordingly, given some initial states in the vector field, they naturally belong to the basins of attraction of the corresponding limit cycles. After that, the Newton–Raphson algorithm is utilized to locate the limit cycles via locating one point on each limit cycle. In the end, the objects' boundaries are represented by integral equations. Without using the time-consuming level-set methods like most of the ACMs, the proposed algorithm can achieve multiple-boundary extraction by placing some initial states in the vector field. In addition, it runs more competently since the Newton–Raphson algorithm is carried out in the Poincaré section, a lower dimensional subspace of the image domain, while the long-established ACMs evolve the contour in the whole image area.

IV. Conclusion

Active contour models (ACMs) integrated with various kinds of external force fields to pull the contours to the exact boundaries have shown their powerful abilities in object segmentation. However, local minimum problems still exist within these models. The current state of the art in image segmentation mostly cornered to furbish active contour models for domain specific image segmentation, more specific to medical images. The majority of the interactive approaches mainly targeting the accuracy of the segmentation process results. It is clearly evident that these interactive models probabilistic due to the role of the observers and in recent literature, it is hard to find interactive models with optimal resource utilization and computational efficiency. Hence the research scope in interactive image segmentation is optimistic. On other side the statistical and numerical analysis models introduced in recent literature are more specific to contextual issues of the domain to which the input images are belongs to. Hence it is clear evident of scope to perform research that introduce machine learning and data engineering approaches those can generalize the optimistic statistical and numerical methods to improve the computational performance and minimal resource usage in active contour based image segmentation.

References Références Referencias

1. Chunming Li; Chiu-Yen Kao; Gore, J.C.; Zhaohua Ding; , "Minimization of Region-Scalable Fitting Energy for Image Segmentation," Image Processing, IEEE Transactions on , vol.17, no.10, pp.1940-1949, Oct. 2008; doi: 10.1109/TIP.2008.2002304;

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2. Bovenkamp, E.G.P.; Dijkstra, J.; Bosch, J.G.; Reiber, J.H.C.; , "User-Agent Cooperation in Multiagent IVUS Image Segmentation," Medical Imaging, IEEE Transactions on , vol.28, no.1, pp.94-105, Jan. 2009; doi: 10.1109/TMI.2008.927351;
3. Srinivasa, G.; Fickus, M.C.; Yusong Guo; Linstedt, A.D.; Kovacevic, J.; , "Active Mask Segmentation of Fluorescence Microscope Images," Image Processing, IEEE Transactions on , vol.18, no.8, pp.1817-1829, Aug. 2009; doi: 10.1109/TIP.2009.2021081
4. Wenxian Yang; Jianfei Cai; Jianmin Zheng; Jiebo Luo;, "User-Friendly Interactive Image Segmentation Through Unified Combinatorial User Inputs," Image Processing, IEEE Transactions on , vol.19, no.9, pp.2470-2479, Sept. 2010; doi: 10.1109/TIP.2010.2048611
5. Ping-Feng Chen; Krim, H.; Mendoza, O.L.; , "Multiphase Joint Segmentation-Registration and Object Tracking for Layered Images," Image Processing, IEEE Transactions on , vol.19, no.7, pp.1706-1719, July 2010; doi: 10.1109/TIP.2010.2045164
6. Figueiredo, I.N.; Figueiredo, P.N.; Stadler, G.; Ghattas, O.; Araujo, A.; , "Variational Image Segmentation for Endoscopic Human Colonic Aberrant Crypt Foci," Medical Imaging, IEEE Transactions on , vol.29, no.4, pp.998-1011, April 2010; doi: 10.1109/TMI.2009.2036258
7. Yazdanpanah, A.; Hamarneh, G.; Smith, B.R.; Sarunic, M.V.; , "Segmentation of Intra-Retinal Layers From Optical Coherence Tomography Images Using an Active Contour Approach," Medical Imaging, IEEE Transactions on , vol.30, no.2, pp.484-496, Feb. 2011; doi: 10.1109/TMI.2010.2087390
8. Delu Zeng; Zhiheng Zhou; Shengli Xie; , "Image Segmentation Based on the Poincaré Map Method," Image Processing, IEEE Transactions on , vol.21, no.3, pp.946-957, March 2012; doi: 10.1109/TIP.2011.2168408
9. Nguyen, T.; Cai, J.; Zhang, J.; Zheng, J.; , "Robust Interactive Image Segmentation Using Convex Active Contour," Image Processing, IEEE Transactions on , vol.PP, no.99, pp.1; doi: 10.1109/TIP.2012.2191566
10. T. Fukuda, Y. Morimoto, S. Morishita, and T. Tokuyama, "Theory of communication," ACM Transactions on Database Systems, vol. 26, no. 2, pp. 179–213, 2001.
11. M. Kass, A. Witkin, and D. Terzopoulos, "Snakes, active contour model," International Journal of Computer Vision, pp. 321–331, 1988
12. S. Osher and J. Sethian, "Fronts propagating with curvature dependent speed: Algorithms based on hamilton-jacobi formulations," Journal of Computationl Physics, pp. 12–49, 1988.
13. J. Canny, "A computational approach to edge detection," IEEE Transactions on Pattern Analysis and Machine Intelligence, no. 8, p. 769, 1986.
14. A. Jain, Fundamentals of Digital Image Processing. Prentice Hall Information and System Sciences Series, Prentice Hall, 1989
15. C. Brice and C. Fennema, Computer Method in Image Analysis, ch. Scene Analysis using Regions, Los Angeles: IEEE Computer Society, 1977
16. S. Zhu and A. Yuille, "Region competition: Unifying snakes, region growing, and bayes/MDL for multiband image segmentation," IEEE Transactions on Pattern Analysis and Machine Intelligence, no. 9, pp. 884–200, 1996.
17. S. Zhu and A. Yuille, "Region competition and its analysis: a unified theory for image segmentation," Tech. Rep. 7, Robotics Lab, Havard University, 1995.
18. K. Fu, R. Gonzales, and C. Lee, Robotics: Control, Sensing, Vision, and Inteligence. New York: McGraw-Hill, 1987.
19. R. Gonzales and R.Woods, Digital Image Processing. Addison-Wesley Publishing, 1st ed., 1993.
20. D. Young, "Active contour models (snakes)." http://www.cogs.susx.ac.uk/users/davidy/teachvision/vision7.html, March 1995.
21. N. Paragios, O. Mellina-Gottardo, and V. Ramesh, "Gradient vector flow fast geometric active contours," IEEE Transactions on Pattern Analysis and Machine Intelligence, no. 3, pp. 402–407, 2004.
22. N. Paragios, O. Mellina-Gottardo, and V. Ramesh, "Gradient vector flow fast geodesic active contours," in Proc. of IEEE International Conference on Computer Vision, 2001.
23. C. Xu and J. Prince, Handbook of Medical Imaging: Processing and Analysis Management, ch. Gradient Vector Flow Deformable Models. Academic Press, 2000
24. C. Xu, D. Pham, and J. Prince, Handbook of Medical Imaging: Processing and Analysis Management, ch. Image Segmentation Using Deformable Models, pp. 129–174. Academic Press, 2000
25. C. Xu and J. Prince, "Generalized gradient vector flow external forces for active contours," Signal Processing, no. 3, pp. 131–139, 1998
26. C. Xu and J. Prince, "Snakes, shapes, and gradient vector flow," IEEE Transactions on Image Processing, no. 3, pp. 359–369, 1998.
27. C. Xu and J. Prince, "Gradient vector flow: a new external force for snakes," in Proc. of IEEE Conference on Computer Vision and Pattern Recognition, pp. 66–71, 1997.
28. L. Vese, Geometric Level Set Methods in Imaging, Vision, and Graphics, ch. Multiphase Object

Detection and Image Segmentation, pp. 175–194. New York: Springer-Verlog, 2003.
29. L. Vese and T. Chan, “A multiphase level set framework for image segmentation using the mumford and shah model,” International Journal of Computer Vision, no. 3, pp. 271–293, 2002.
30. T. Chan and L. Vese, “A level set algorithm for minimizing the mumford-shah functional in image processing,” in Proc. of IEEE Workshop on Variational, Geometric and Level Set Methods in Computer Vision, pp. 161–168, 2001.
31. L. Vese and T. Chan, “A multiphase level set framework for image segmentation using the mumford and shah model,” Tech. Rep. 0125, Computational Applied Math Group, UCLA, 2001.
32. T. Chan and L. Vese, “A level set algorithm for minimizing the mumford-shah functional in image processing,” Tech. Rep. 0013, Computational Applied Math Group, UCLA, 2000.
33. N. Paragios and R. Deriche, “Geodesic active regions: A new framework to deal with frame partition problems in computer vision,” Journal of Visual Communication and Image Representation, pp. 249–268, 2002.
34. N. Paragios, Geodesic Active Regions and Level Set Methods: Contributions and Applications in Artificial Vision. PhD thesis, Dept. of Electrical and Computer Engineering, INRIA, 2000
35. N. Paragios and R. Deriche, “Unifying boundary and region-based information for geodesic active tracking,” in Proc. of IEEE Conference on Computer Vision and Pattern Recognition, pp. 300–305, 1999
36. N. Paragios and R. Deriche, “Coupled geodesic active regions for image segmentation: a level set approach,” in Proc. of European Conference on Computer Vision, 2000.
37. N. Paragios and R. Deriche, “Coupled geodesic active regions for image segmentation,” Tech. Rep. 3783, INRIA, 1999
38. N. Paragios, “A variational approach for the segmentation of the left ventricle in cardiac image analysis,” International Journal of Computer Vision, no. 3, pp. 345–362, 2002
39. N. Paragios, “A variational approach for the segmentaion of the left ventricle in mr cardiac images,” in Proc. of IEEE Workshop on Variational, Geometric and Level Set Methods in Computer Vision, 2001.
40. S. Jehan-Besson, M. Barlaud, and G. Aubert, “Shape gradients for histogram segmentation using active contours,” in Proc. of IEEE International Conference on Computer Vision, 2003.
41. S. Jehan-Besson, M. Barlaud, and G. Aubert, “Region-based active contours using geometrical and statistical features for image segmentation,” in Proc. of IEEE International Conference on Image Processing, pp. 643–646, 2003.
42. S. Osher and J. Sethian, “Fronts propagating with curvature-dependent speed: algorithms based on Hamilton-Jacobi formulations,” J. Comput. Phys, vol. 79, pp. 12–49, 1988
43. L. Grady, “Random walks for image segmentation,” IEEE Trans. PAMI, vol. 28, no. 11, pp. 1768–1783, Nov. 2006
44. A. Kim and H. Krim, “Hierarchical stochastic modeling of sar imagery for segmentation/compression,” IEEE Trans. Signal Process., vol. 47, no. 2, pp. 458–468, Feb. 1999.
45. M. Irani, P. Anandan, and S. Hsu, “Mosaic based representations of video sequences and their applications,” in Proc. IEEE Int. Conf. Computer Vision, 1995, p. 605
46. L. M. G. Fonseca, D. Fedorov, B. S. Manjunath, C. Kenney, E. Castejon, and J. S. de Medeiros, “Automatic registration and mosaicking system for remotely sensed imagery,” Revista Brasileira de Cartografia, vol. 58, pp. 49–61, 2006.
47. D. L. Hall, Mathematical Techniques in Multisensor Data Fusion. Norwood, MA: Artech House, 1992
48. L. A. Klein, Sensor and Data Fusion Concepts and Applications. Bellingham, WA: SPIE, 1993
49. D. Hall and J. Llinas, “An introduction to multisensor data fusion,” Proc. IEEE, vol. 85, no. 1, pp. 6–23, Jan. 1997.
50. B. Zitova and J. Flusser, “Image registration methods:Asurvey,” Image Vis. Comput., vol. 21, no. 11, pp. 977–1000, 2003.
51. Y. He, A. Hamza, and H. Krim, “A generalized divergence measure for robust image registration,” IEEE Trans. Signal Process., vol. 51, no. 5, pp. 1211–1220, May 2003
52. Q. Zheng and R. Chellappa, “A computational vision approach to image registration,” IEEE Trans. Image Process., vol. 2, no. 3, pp. 311–326, Jul. 1993
53. C. Shekhar, V. Govindu, and R. Chellappa, Multisensor Image Registration by Feature Consensus 1996.
54. R. Kumar, H. Sawhney, J. Asmuth, A. Pope, and S. Hsu, “Registration of video to geo-referenced imagery,” in Proc. 14th International Conf. Pattern Recognition, Aug. 1998, vol. 2, pp. 1393–1400.
55. S. Jwa, U. Ozguner, and Z. Tang, “Information-theoretic data registration for uav-based sensing,” IEEE Trans. Intell, Transp. Syst,, vol. 9, no. 1, pp. 5–15, Mar. 2008.
56. R. Kumar, S. Samarasekera, S. Hsu, and K. Hanna, “Registration of highly-oblique and zoomed in aerial video to reference imagery,” in Proc. 15th Int. Conf. Pattern Recognition, 2000, vol. 4, pp. 303–307.
57. V. Caselles, F. Catté, T. Coll, and F. Dibos, “A geometric model for active contour in image processing” Numer, Math., vol. 66, pp. 1–31, 1993

58. T. F. Chan and L. A. Vese, “Active contours without edges,” IEEE Trans. Image Process., vol. 10, no. 2, pp. 266–277, Feb. 2001
59. D. Mumford and J. Shah, “Optimal approximations by piecewise smooth functions and associated variational problems,” Comm. Pure Appl. Math., vol. 42, no. 5, pp. 577–685, 1989.
60. S. Osher and R. Fedkiw, Level Set Methods and Dynamic Implicit Surfaces, New York: Springer-Verlag, 2003, vol. 153, Applied Mathematical Sciences.
61. S. Osher and J. A. Sethian, “Fronts propagating with curvature-dependent speed: Algorithms based on Hamilton-Jacobi formulations,” J. Comput. Phys., vol. 79, no. 1, pp. 12–49, 1988
62. J. A. Sethian, Level Set Methods and Fast Marching Methods, 2nd ed. Cambridge, U.K.: Cambridge Univ. Press, 1999, vol. 3, Cambridge Monographs on Applied and Computational Mathematics.
63. D. C. Fern´andez, H. M. Salinas, and C. A. Puliafito, “Automated detection of retinal layer structures on optical coherence tomography images,” Opt. Express, vol. 13, no. 25, pp. 10 200–10 216, 2005.
64. D. C. Fern´andez, “Delineating fluid-filled region boundaries in optical coherence tomography images of the retina,” IEEE Trans. Med. Imag., vol. 24, no. 8, pp. 939 – 945, 2005.
65. A. M. Bagci, M. Shahidi, R. Ansari, M. Blair, N. P. Blair, and R. Zelkha, “Thickness profiles of retinal layers by optical coherence tomography image segmentation,” American Journal of Ophthalmology, vol. 146, no. 5, pp. 679 – 687, 2008.
66. D. Koozekanani, K. Boyer, and C. Roberts, “Retinal thickness measurements from optical coherence tomography using a Markov boundary model,” IEEE Trans. Med. Imag., vol. 20, no. 9, pp. 900–916, 2001.
67. R. J. Zawadzki, A. R. Fuller, D. F. Wiley, B. Hamann, S. S. Choi, and J. S. Werner, “Adaptation of a support vector machine algorithm for segmentation and visualization of retinal structures in volumetric optical coherence tomography data sets,” Journal of Biomedical Optics, vol. 12, no. 4, pp. 041 206, 1–8, 2007.
68. A. R. Fuller, R. J. Zawadzki, S. Choi, D. F. Wiley, J. S. Werner, and B. Hamann, “Segmentation of three-dimensional retinal image data,” Visualization and Computer Graphics, IEEE Transactions on, vol. 13, no. 6, pp. 1719–1726, 2007.
69. M. Garvin, M. Abramoff, R. Kardon, S. Russell, X. Wu, and M. Sonka, “Intraretinal layer segmentation of macular optical coherence tomography images using optimal 3-D graph search,” Medical Imaging, IEEE Transactions on, vol. 27, no. 10, pp. 1495–1505, 2008.
70. M. Haeker, M. Sonka, R. Kardon, V. A. Shah, X. Wu, and M. D. Abramoff, “Automated segmentation of intraretinal layers from macular optical coherence tomography images,” in Progress in Biomedical Optics and Imaging - Proceedings of SPIE, vol. 6512, 2007, p. 651214.
71. M. Haeker, M. Abrmoff, R. Kardon, and M. Sonka, “Segmentation of the surfaces of the retinal layer from OCT images,” in Medical Image Computing and Computer-Assisted Intervention (MICCAI), 2006, pp. 800–807.
72. M. Garvin, M. Abramoff, X. Wu, S. Russell, T. Burns, and M. Sonka, “Automated 3-D intraretinal layer segmentation of macular spectraldomain optical coherence tomography images,” IEEE Trans. Med. Imag., vol. 28, no. 9, pp. 1436 –1447, 2009.

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Preprocessing Technique for Face Recognition Applications under Varying Illumination Conditions

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Abstract - In the last years, face recognition has become a popular area of research in computer vision, it is typically used in network security systems and access control systems but it is also useful in other multimedia information processing areas. Performance of the face verification system depends on many conditions. One of the most problematic is varying illumination condition. In this paper, we discuss the preprocessing method to solve one of the common problems in face images, due to a real capture system i.e. lighting variations. The different stages include gamma correction, Difference of Gaussian (DOG) filtering and contrast equalization. Gamma correction enhances the local dynamic range of the image in dark or shadowed regions while compressing it in bright regions and is determined by the value of γ. DOG filtering is a grey scale image enhancement algorithm that eliminates the shadowing effects. Contrast equalization rescales the image intensities to standardize a robust measure of overall intensity variations. The technique has been applied to Yale-B data sets, Face Recognition Grand Challenge (FRGC) version 2 Experiment 4 and a real time created data set.

Keywords : Face Recognition, Gamma Correction, Illumination, Dog Filtering, Image Preprocessing, Contrast Equalization.

GJCST-F Classification: I.5.4

PREPROCESSING TECHNIQUE FOR FACE RECOGNITION APPLICATIONS UNDER VARYING ILLUMINATION CONDITIONS

Strictly as per the compliance and regulations of:

Preprocessing Technique for Face Recognition Applications under Varying Illumination Conditions

S.Anila [α] & Dr.N.Devarajan [σ]

Abstract - In the last years, face recognition has become a popular area of research in computer vision, it is typically used in network security systems and access control systems but it is also useful in other multimedia information processing areas. Performance of the face verification system depends on many conditions. One of the most problematic is varying illumination condition. In this paper, we discuss the preprocessing method to solve one of the common problems in face images, due to a real capture system i.e. lighting variations. The different stages include gamma correction, Difference of Gaussian (DOG) filtering and contrast equalization. Gamma correction enhances the local dynamic range of the image in dark or shadowed regions while compressing it in bright regions and is determined by the value of γ. DOG filtering is a grey scale image enhancement algorithm that eliminates the shadowing effects. Contrast equalization rescales the image intensities to standardize a robust measure of overall intensity variations. The technique has been applied to Yale-B data sets, Face Recognition Grand Challenge (FRGC) version 2 Experiment 4 and a real time created data set.

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I. Introduction

A biometric recognition system is an automated system that verifies or identifies a person's identity using a person's physiological characteristics and/or behavioral characteristics [Jain et al., 2004]. Face recognition has been growing rapidly in the past few years for its multiple uses in the areas of Law Enforcement, Biometrics, Security, and other commercial uses. As one of the most successful applications of image analysis and understanding, face recognition has recently gained significant attention, especially during the past several years. There are at least two reasons for such a trend: the first is the wide range of commercial and law enforcement applications and the second is the availability of feasible technologies after several years of research [Zhao et al, 2003].

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Face is one of the most common parts used by people to recognize each other. Over the course of its evolution, the human brain has developed highly specialized areas dedicated to the analysis of the facial images.

While face recognition has increased in reliability significantly it is still not accurate all the time. The ability to correctly classify the image depends on a variety of variables including lighting, pose (Gross and Brajovic, 2003), facial expressions (Georghiades et al, 2001) and image quality (Shan et al, 2003). In the past decades, face recognition has been an active research area and many types of algorithms and techniques have been proposed to equal this ability of human brain. It is however questioned whether the face itself is a sufficient basis for recognizing a person from large population with great accuracy. Indeed, the human brain also relies on much contextual information and operates on limited population. This is evidenced by the emergence of specific face recognition conferences such as AFGR[1997, 1999] and AVBPA[1995-1998] and systematic empirical evaluation of Face Recognition Techniques [FRT], including the FERET [Phillips et al. [1997], [Rizvi et al 1998] and XM2VTS[Messer et al., 1999] protocols.

The most problematic perturbation affecting the performance of face recognition systems are strong variations in pose and illumination. Variation between images of different faces in general is smaller than taken from the same face in a variety of environments. More specifically the changes induced by illumination could be larger than the differences between individuals, causing systems based on comparing images to misclassify the identity of the input image [Adini et al., 1997]. i.e. The differences between images of one face under different illumination conditions are greater than the differences between images of different faces under the same illumination conditions.

The face verification system authenticates a person's claimed identity and decides that claimed identity is correct or not. In this case it has limited user group and in the most cases it can be forced or demand frontal pose orientations. But, still there are many problems with illumination condition. Face recognition tests revealed that the lighting variant is one of the bottlenecks in face recognition/verification. If lighting conditions are different from the gallery, identity decision is wrong in many cases. There are two approaches to this problem. Model- based, and preprocessing-based (Adini et al.,1997) and (Rabia Jafri and Hamid R.Arabnia, 2009). Model-based approach makes an attempt to model the light variation. Unfortunately, this requires large amount of training data and sometimes fail when there is a complicated lighting configuration. The second approach using preprocessing method removes lighting influence effect without any additional knowledge. So these methods are not practical enough for recognition systems in most cases. But, the approaches based on image processing techniques transform images directly without any assumptions or prior knowledge. Therefore, they are commonly used in practical systems for their simplicity and efficiency. Except the traditional method such as histogram equalization (HE) (Dalal and Triggs, 2005), histogram specification (HS), logarithm transformation (LOG), new methods belonging to this category such as Gamma Intensity Correction (GIC) and self-quotient image (SQI) (Wang et al., 2004) have been proposed recently with impressive performance improvement for illumination problem.

We can also carry out some analysis. For example, the popular Eigen subspace projections used in many systems as features have been analyzed under illumination variation [Adini et al., 1997]. The conclusions suggest that significant illumination changes cause dramatic changes in the projection coefficient vectors, and hence can seriously degrade the performance of subspace based methods [Zhao, 1999]. In direct appearance-based approaches, training examples are collected under different lighting conditions and directly (i.e. without undergoing any lighting preprocessing) used to learn a global model of the possible illumination variations, for example a linear subspace or manifold model, which then generalizes to the variations seen in new images [Belhumeur and Kriegman, 1998], [Basri and Jacobs, 2003], [Lee et al., 2005], [Chen et al.,2000] and [Zhang and Samaras 2003].

The robustness of several popular linear subspace methods and of Local Binary Patterns (LBP) can be substantially improved by including a very simple image preprocessing stage based on gamma correction, Difference of Gaussian filtering and robust variance normalization [Tan and Triggs, 2010]. The INface (Illumination Normalization techniques for robust Face recognition) toolbox in its current form is a collection of functions which perform illumination normalization and, hence, tackle one of the greatest challenges in face recognition [V. ˇStruc and N Paveˇsi´c, 2009]. The proposed method is presented in the conference [Anila and Devarajan, 2011].

II. Typical Preprocessing Methods

The methods based on image processing techniques for illumination problem commonly attempt to normalize all the face images to a canonical illumination in order to compare them under the "identical" lighting conditions. These methods can be formulated as a uniform form:

$$I' = T(I) \qquad (1)$$

Where 'I' is the original image, T is the transformation operator I'is the image after the transform. The transform T is expected to weaken the negative effect of the varying illumination and the image I'can be used as a canonical form for a face recognition system. Therefore, the recognition system is expected to be insensitive to the varying lighting conditions. Histogram equalization (HE), Histogram specification (HS) and logarithm transform (LOG) are the most commonly used methods for gray-scale transform. Gamma Intensity Correction (GIC) and Multi Scale Retinex (MSR) were supposed to weaken the effect of illumination variations in face recognition. All these methods are briefly introduced in the following sections and compared with the proposed method.

a) Histogram Equalization (HE) And Histogram Specification (HS)

Histogram Normalization is one of the most commonly used methods for preprocessing. In image processing, the idea of equalizing a histogram is to stretch and redistribute the original histogram using the entire range of discrete levels of the image, in a way that an enhancement of image contrast is achieved. The most commonly used histogram normalization technique is histogram equalization where one attempts to change the image histogram into a histogram that is constant for all brightness values. This would correspond to a brightness distribution where all values are equally probable. For image I(x,y) with discrete k gray values histogram is defined by i.e. the probability of occurrence of the gray level i is given by:

$$p(i) = \frac{n_i}{N} \qquad (2)$$

Where $i \in 0, 1\ldots k-1$ grey level and N is total number of pixels in the image. Transformation to a new intensity value is defined by:

$$I_{out} = \sum_{i=0}^{k-1} \frac{n_i}{N} = \sum_{i=0}^{k-1} p(i) \qquad (3)$$

Output values are from domain of [0, 1].To obtain pixel values in to original domain, it must be rescaled by the $K-1$ value. Fig.1 shows the histogram equalization.

The widespread histogram equalization cannot correctly improve all parts of the image. When the original image is irregularly illuminated, some details on resulting image will remain too bright

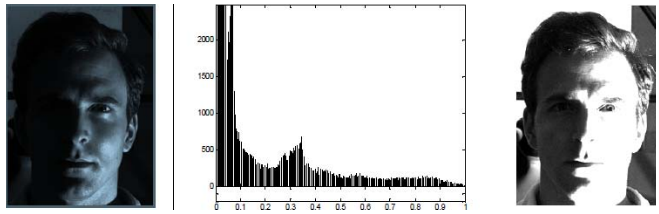

Fig.1 : An original image, its histogram, Linear histogram equalization from left to right

or too dark. These are most commonly used techniques of histogram adjustment. HE is to create an image with uniform distribution over the whole brightness scale and HS is to make the histogram of the input image have a predefined shape.

b) LOG

LOG is another frequently used technique of gray Scale transform. It simulates the logarithmic sensitivity of the human eye to the light intensity. Although LOG is one of the best methods in dealing with the variations in lighting on the three databases; it decreases the recognition rates on the other subsets of the CAS-PEAL database greatly. One possible reason is that the difference between the mean brightness values of the transformed images belonging to the same person is too large.

c) GIC

The Gamma Intensity Correction (GIC) corrects the overall brightness of a face image to a pre-defined canonical face image. Thus the effect of varying lighting is weakened.

d) SQI

SQI is based on the reflectance-illumination model: I = RL, where I is the image, R is the reflectance of the scene and L is the lighting. The lighting L can be considered as the low frequency component of the image I and can be estimated by a low-pass filter F , i.e., L ~ F * I . Thus we can get the self-quotient image as

$$R = \frac{I}{F*I} \quad (4)$$

It uses a weighted Gaussian filter that convolutes with only the large part in edge regions. Thus the halo effects can be reduced. When the lighting variations are large (such as the "illum" subset of the CMU-PIE database), the edges induced by lighting are prominent and this method can work well. However, when lighting variations are not so obvious, the main edges are induced by the facial features. If this kind of filter is still used, the useful information for recognition will be weakened. This is a possible reason that it decreases the recognition rates on the FERET and CAS-PEAL datasets while increasing the recognition rates on the CMU-PIE database.

Fig.2 gives some examples (under varying lighting conditions) of the images after these transformation operations.

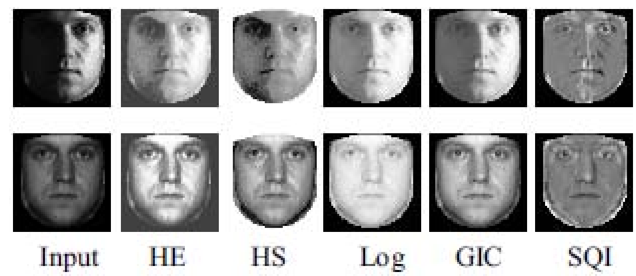

Fig. 2 : Example Effects of the Typical Preprocessing Methods

From Fig.2, the results show that HE, HS and GIC are better than the other two methods. (Some images in the FERET database had been processed. Therefore HE has little improvement on it.) Furthermore, they need no complex operations and the complexity of time and space is not high. However, the above example shows that these preprocessing approaches do not always work well on different datasets. Furthermore, some approaches may hurt the recognition of face images with normal lighting, though they do facilitate the recognition of face images with illumination variations. So it is necessary to improve the preprocessing method for varying light condition face images in order to guide the application to practical systems. The strengths of gamma correction, DOG filter and contrast equalization techniques have been combined and the net effect has been utilized in the proposed technique.

III. Proposed Technique

The proposed method combines the features of gamma correction, DOG filtering and contrast equalization techniques. Over all stages of proposed preprocessing method is shown in Fig.3.

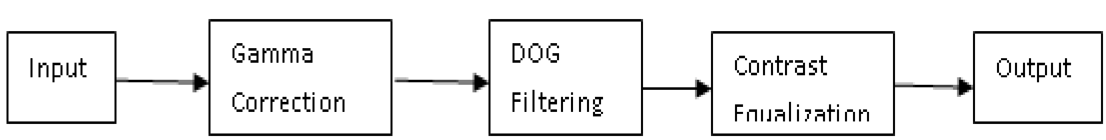

Fig. 3 : The Stages of Proposed Image Preprocessing Method

The rest of the paper is organized as follows. Section II Presents Gamma correction, DOG Filtering and contrast equalization technique with the results and Section III reports the conclusion.

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a) Gamma Correction

Gamma Correction is a nonlinear gray-level transformation that replaces gray-level I with the gray level $I^{1/\gamma}$, and is given by,

$$I = I^{1/\gamma} \qquad (5)$$

(for > 0) or log(/) (for = 0), where ∈ [0, 1] is a user-defined parameter. This enhances the local dynamic range of the image in dark or shadowed regions while compressing it in bright regions.

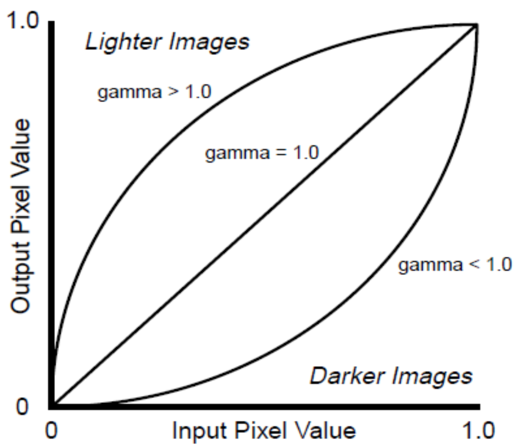

Fig. 4 : Gamma Curve

This curve is valuable in keeping the pure black parts of the image black and the white parts white, while adjusting the values in-between in a smooth manner. Thus, the overall tone of an image can be lightened or darkened depending on the gamma value used, while maintaining the dynamic range of the image. In Figure 4, the pixel values range from 0.0 represents pure black, to 1.0, which represents pure white. As the figure shows, gamma values of less than 1.0 darken an image. Gamma values greater than 1.0 lighten an image and a gamma value equal to 1.0 produces no effect on an image. A power law with exponent in the range [0, 0.5] is a good compromise. Here = 0.2[Tan and Triggs, 2010] is used as the default setting.

b) Difference Of Gaussian(Dog) Filtering

Gamma correction does not remove the influence of overall intensity gradients such as shading effects. In computer vision, Difference of Gaussians is a grayscale image enhancement algorithm that involves the subtraction of one blurred version of an original grayscale image from another, less blurred version of the original. The blurred images are obtained by convolving the original grayscale image with Gaussian kernels having differing standard deviations. Blurring an image using a Gaussian kernel suppresses only high-frequency spatial information. Subtracting one image from the other preserves spatial information that lies between the ranges of frequencies that are preserved in the two blurred images. Thus, the difference of Gaussians is a band-pass filter that discards all but a handful of spatial frequencies that are present in the original grayscale image. As an image enhancement algorithm, the Difference of Gaussian (DOG) can be utilized to increase the visibility of edges and other detail present in a digital image. The Difference of Gaussians algorithm removes high frequency detail that often includes random noise and this approach could be found well suitable for processing images with a high degree of noise.

The DOG impulse response is defined as:

$$DOG(x,y) = \frac{1}{2\pi\sigma_1{}^2} e^{-\frac{x^2+y^2}{2\sigma_1{}^2}} - \frac{1}{2\pi\sigma_2{}^2} e^{-\frac{x^2+y^2}{2\sigma_2{}^2}} \qquad (6)$$

Where the default values of τ_1 and τ_2 are chosen as 1.0 and 2.0 respectively. Since this effect leads to the reduction in the overall contrast produced by the operation and hence the contrast has to be enhanced in the subsequent stages.

c) Contrast Equalization

The final stage of the preprocessing chain rescales the image intensities. It is important to use a robust estimator because the signal typically contains extreme values produced by highlights, small dark regions such as nostrils, garbage at the image borders, etc. One could use (for example) the median of the absolute value of the signal for this, but here a simple and rapid approximation is preferred based on a two stage process as follows:

$$I(x,y) = \frac{I(x,y)}{(mean\ (\min(\tau, |I(x',y')|)^{\alpha}))^{1/\alpha}} \qquad (7)$$

$$I(x,y) = \frac{I(x,y)}{(mean\ (|I(x',y')|^{\alpha}))^{1/\alpha}} \qquad (8)$$

Here, α is a strongly compressive exponent that reduces the influence of large values, τ is a threshold used to truncate large values after the first phase of normalization, and the mean is over the whole (unmasked part of the) image. By default we use α = 0:1 τ = 10[Tan and Triggs, 2010].

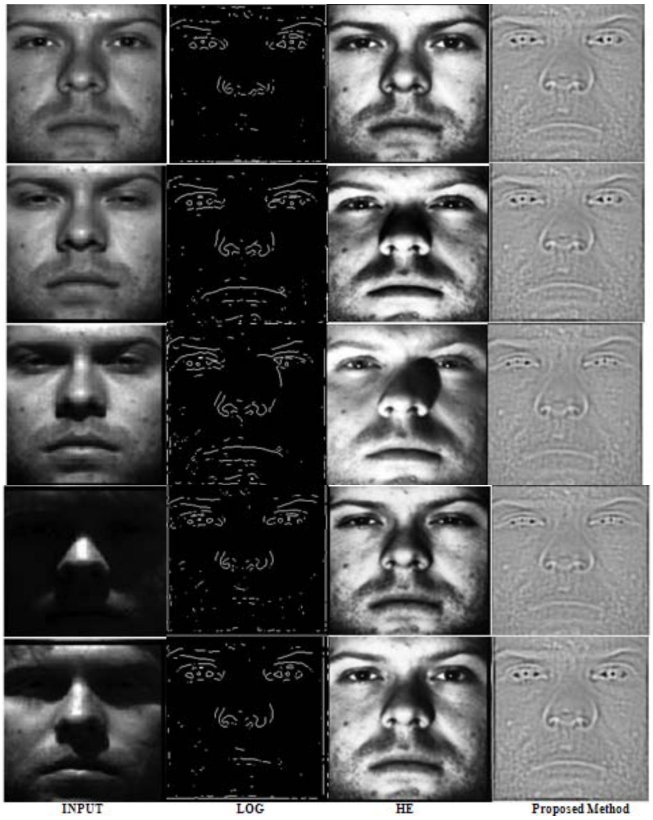

Fig. 5 : Comparison of Various Techniques with Difficult Lighting Condition

Fig.5 shows the different methods of performing the preprocessing. It could be observed that the images are taken under different lighting conditions, varying from very bright to very dark. By comparing, we could observe that the preprocessing performed using the proposed method is better when compared to LOG and HE.

The proposed technique is tested with the different datasets Yale B, FRGC-204 and Real time Database that has been created under difficult and different illumination conditions. For each person five images are created as normal, bright, very bright, dark and very dark. The images are tested with the proposed algorithm, preprocessing is performed which is the first stage of any face recognition system.

Table I : Default Parameter Settings [Tan and Triggs, 2010]

Procedure	Parameter	Value
Gamma correction	γ	0.2
DOG Filtering	σ0	1
Contrast	σ1	2
Equalization	α	0.1
	τ	10

IV. Conclusion

A new technique of preprocessing has been proposed for face recognition applications under uncontrolled and difficult lighting conditions. It could be achieved by using a simple, efficient image preprocessing chain whose practical recognition performance will be high when compared to the techniques where face recognition is performed without preprocessing. The technique has been carried out by combining the strengths of gamma correction, Difference of Gaussian filtering and Contrast equalization.

References Références Referencias

1. Y. Adini, Y. Moses, and S. Ullman, "Face recognition: The problem of compensating for changes in illumination direction," IEEE Trans. Pattern Anal. Mach. Intell., vol. 19, no. 7, pp. 721–732, Jul. 1997.
2. S.Anila & Dr.N.Devarajan, "An efficient Preprocessing Technique under difficult Lighting Conditions," in Proc. National Conference on Emerging Trends in Computer Communication and Informatics (ETCCI-2011), March 10-11, 2011.
3. R. Basri and D. Jacobs, "Lambertian reflectance and linear subspaces," IEEE Trans. Pattern Analysis & Machine Intelligence, vol. 25, no. 2, pp. 218–233, February 2003.
4. P. Belhumeur and D. Kriegman, "What is the set of images of an object under all possible illumination conditions," Int. J. Computer Vision, vol. 28, no. 3, pp. 245–260, 1998.
5. H. Chen, P. Belhumeur, and D. Jacobs, "In search of illumination invariants," in CVPR, 2000, pp. I: 254–261.
6. N. Dalal and B. Triggs, "Histograms of oriented gradients for human detection," in Proc. CVPR, Washington, DC, 2005, pp. 886–893.
7. A.S. Georghiades, P.N. Belhumeur and D.J. Kriegman "From Few to Many: Illumination Cone Models for Face Recognition under Differing Pose and Lighting," IEEE TPAMI, 23(6): 643-660, 2001.
8. R. Gross and V. Brajovic, "An image preprocessing algorithm for illumination invariant face recognition," in Proc. AVBPA, 2003, pp. 10-18.
9. A. K. Jain, A. Ross, and S. Prabhakar, "An introduction to biometric recognition," *IEEE Trans. Circuits Syst. Video Technol.*, vol. 14, no. 1,pp. 4–20, Jan. 2004.
10. K. Lee, J. Ho, and D. Kriegman, "Acquiring linear subspaces for face recognition under variable lighting," IEEE Trans. Pattern Analysis & Machine Intelligence, vol. 27, no. 5, pp. 684–698, 2005.
11. K. Messer, J. Matas, J. Kittler, J. Luettin and G. Maitre, " XM2VTSDB: The Extended M2VTS Database", in Proc. International Conference on Audio- and Video-Based Person Authentication, pp.72-77, 1999.

12. P.J. Phillips, H. Moon, P. Rauss, and S.A. Rizvi, “The FERET Evaluation Methodology for Face-Recognition Algorithms”, in Proc. Conference on Computer Vision and Pattern Recognition”, pp.137-143, 1997.
13. Proceedings of the International Conferences on Automatic Face and Gesture Recognition, 1995-1998.
14. Proceedings of the International Conferences on Audio- and Video-Based Person Authentication, 1997, 1999.
15. Rabia Jafri and Hamid R.Arabnia, “A Survey of Face Recognition Techniques,”in journal of information processing systems,vol.5,No.2, June 2009.
16. S.A. Rizvi, P.J. Phillips, and H. Moon, “The FERET Verification Testing Protocol for Face Recognition Algorithms”, in Proc. International Conference on Automatic Face and Gesture Recognition, 1998
17. S. Shan, W. Gao, B. Cao, and D. Zhao, “Illumination normalization for robust face recognition against varying lighting conditions,” in Proc. AMFG, Washington, DC, 2003.
18. H.Wang, S. Li, and Y.Wang, “Face recognition under varying lighting conditions using self-quotient image,” in Proc. IEEE Int. Conf. Autom. Face Gesture Recognition, 2004, pp. 819–824.
19. Xiaoyang Tan and Bill Triggs, “Enhanced Local Texture Feature Sets for Face Recognition Under Difficult Lighting Conditions,” IEEE transactions on image processing, vol. 19, no. 6, june 2010.
20. W. Zhao, R. Chellappa, A. Rosenfeld, P.J. Phillips, Face Recognition: A Literature Survey, ACM Computing Surveys, 2003, pp. 399-458.
21. W. Zhao, Robust Image Based 3D Face Recognition, Ph D Thesis, University of Maryland,1999
22. L. Zhang and D. Samaras, “Face recognition under variable lighting using harmonic image exemplars,” in CVPR, vol. 01, Los Alamitos, CA, USA, 2003, pp. 19–25.
23. ˇStruc and N Paveˇsi´c, ”Performance Evaluation of Photometric Normalization Techniques for Illumination Invariant Face Recognition”, In: Y.J. Zhang (Ed.), Advances in Face Image Analysis: Techniques and Technologies. IGI Global, 2009.

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Performance of Retrieval Information System for Medical Images

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Abstract - Problem statement : In this article the principles of building knowledge and retrieval information system will be applied to medical images in some studied hospital. Since there is a huge number of medical images this system will organizes and manages the operation of retrieving and displaying such images to the persons who need such images in short time and in high quality services.

Approach : From relevance assessments we can compute measures of retrieval performance such as: Recall (R), discrimination DC, and Precision. Results: both recall and precision of the system are linearly depend on relevant items correctly retrieved.

Conclusion : Number of retrieved images from huge total number of medical images in some hospital determine the systems' recall, discrimination, and precision of the retrieval information system.

Keywords : *Knowledge systems, retrieval information systems, medical images.*

GJCST-F Classification: *J.3*

PERFORMANCE OF RETRIEVAL INFORMATION SYSTEM FOR MEDICAL IMAGES

Strictly as per the compliance and regulations of:

Performance of Retrieval Information System for Medical Images

Hazem (Moh'd Said) Hatamleh [α], Ahmed A.M Sharadqeh [σ], As'ad Mahmoud Alnaser [ρ], Omar Alheyasat [Ѡ] & Ashraf Abdel-Karim Abu-Ein [¥]

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I. Introduction

With the availability of digital medical image acquisition devices and the rapid growth of computing power, effective retrieval of digital medical images in a large database is a challenging research point. The health and medical related professions use and store the patients' visual information in the form of ultrasound, X-rays or other types of scanned images for the purpose of diagnosis and monitoring. The availability and optimal use of these medical images with respect to medical diagnosis and allied purposes is a function of how these images are stored and retrieved, [1, 2].

Region based signature can be acquired by image segmentation. Reliable segmentation is also critical to get the image shape description. However, content-based medical image retrieval that confront many image types, some of them even have not a clear object, so some strategies for dealing with this problem is to reduce dependence on accurate image segmentation for a practical image retrieval system. The increasing reliance of modern medicine on diagnostic techniques such as radiology, histopathology, and computerized tomography has resulted in an explosion in the number and importance of medical images now stored by most hospitals. While the prime requirement for medical imaging systems is to be able to display images relating to a named patient, there is increasing interest in the use of CBIR techniques to aid diagnosis by identifying similar past cases. Most development work in the PACS (Picture Archiving and Communication Systems) area is still directed towards providing basic functionality (ensuring that medical images can be successfully digitized, stored and transmitted over local area networks without loss of quality) and usability (providing user-centered interfaces and integrating image storage and retrieval with wider aspects of patient record management). However, experimental content-based retrieval systems are beginning to have some impact. Due to the problem of achieving the accurate image segmentation for medical image retrieval; this thesis will deal with strategies to reduce the dependence on accurate image segmentation for a practical image retrieval system. It is desirable for the relevance feedback based on the user participation in image retrieval system to solve the problem of the semantic gap and the image retrieval with low level visual features. Through the user's feedback, the corresponding high-level semantic will be obtained based on machine learning theory. SWETA et al. 2006, Medical images are a critical component of the healthcare system with great impact on the society's welfare. Traditionally medical images were stored on film but the advances in modern imaging modalities made it possible to store them electronically. Thus, this paper proposed a novel framework for classifying various strategies for storing, retrieving and processing digital medical images. In addition to a detailed discussion, the assessment of the classification framework includes a potential usage scenario of the framework. For researchers, this study identified an important strategies and points out future research directions while, for practitioners, the proposed framework might help medical users develop a lucid understanding of the different approaches and their advantages and disadvantages. Cosmin S, 2011, the article presented a software system that implemented a multimedia database management server. The software has a modularized architecture controlled by a relational database system. An element of originality is that along

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with the classical functionality of such a system, it includes specialized modules for extracting texture and color characteristics from images and for executing content based retrieval queries. This system is tested from the speed point of view both for images processing speed and retrieval speed. Mohammad O, et al. 2001, in this paper, they introduced intermediate features. These were low level "semantic features" and "high level image" features. That is, in one hand, they can be arranged to produce high level concept and in another hand, they can be learned from a small annotated database. These features can then be used in an image retrieval system. They reported experiments where intermediate features are textures. These are learned from a small annotated database. The resulting indexing procedure is then demonstrated to be superior to a standard color histogram indexing. Johan M, et al. 2007, their research project was addressing the problem of content-based medical image retrieval in large databases. They were exploiting grids to tackle the computational requirement of this problem. They developed strategies to optimize the load distribution over the very large scale EGEE grid infrastructure, taking into account its properties and load. They have explored several strategies to identify relevant images. Texture features extracted using Gabor filters proved to be an efficient and relevant mean of indexing medical databases. The texture features could be correlated to image modality, tissues, and subtle changes such as myocardium tissues variation during the cardiac cycle. Henry J.et al. 1998, the emergence of Multimedia Electronic Medical Record Systems (MEMRS), architectures that integrate medical images with text-based clinical data, will further hasten this trend. The development of these systems, storing a large and diverse set of medical images, suggests that in the future MEMRS will become important digital libraries supporting patient care, research and education. The representation and retrieval of clinical images within these systems is problematic as conventional database architectures and information retrieval models have, until recently, focused largely on text-based data. Medical imaging data differs in many ways from text-based medical data but perhaps the most important difference is that the information contained within imaging data is fundamentally knowledge-based. New representational and retrieval models for clinical images will be required to address this issue. Within the Image Engine multimedia medical record system project at the University of Pittsburgh they were evolving an approach to representation and retrieval of medical images which combines semantic indexing using the UMLS Metathesuarus, image content-based representation and knowledge-based image analysis. Johan Montagnat et al. 2004, in this paper they studied the impact of executing a medical image database query application on the grid. For lowering the total computation time, the image database is partitioned in subsets to be processed on different grid nodes. A theoretical model of the application computation cost and estimates of the grid execution overhead are used to efficiently partition the database. They showed results demonstrating that smart partitioning of the database can lead to significant improvements in terms of total computation time. Weidong C. et al. 2001, various picture archiving and communications systems (PACS) have been developed to deal with this growing volume of data generated by different systems, providing digital image acquisition, archiving, retrieval, processing, and distribution and communication and display functions.1 In a PACS system, archived medical images can be quickly retrieved electronically. PACS workstations can take advantage of image analysis and processing software to manipulate and enhance image data. However, current PACS systems are expensive and complex. They require a large number of review and display workstations, and each workstation usually requires dedicated licensed software and considerable maintenance support. The high cost of dedicated PACS workstations prevents their deployment at all locations where they would be useful, for example, elsewhere in the same institution and at remote sites such as other institutions or the home. Here, they presented a prototype Web-based medical image data access and manipulation system.

II. Information Retrieval Systems

Information retrieval systems are everywhere: Web search engines, library catalogs, store catalogs, cookbook indexes, and so on. *Information retrieval* (IR), also called *information storage and retrieval* (ISR or ISAR) or *information organization and retrieval*, is the art and science of retrieving from a collection of items a subset that serves the user's purpose; for example:

- Web pages useful in preparing for a trip to Europe;
- Magazine articles for an assignment or good reading for that trip to Europe;
- Educational materials for a learning objective;
- Digital cameras for taking family photos;
- Recipes that use ingredients on hand;
- Facts needed for deciding on a company merger.

The main trick is to retrieve what is useful while leaving behind what is not. [3, 4].

III. Utility, Relevance, and IR System Performance

Utility and relevance underlie all IR operations. A document's utility depends on three things, topical relevance, pertinence, and novelty. A document is *topically relevant* for a topic, question, or task if it contains information that either directly answers the question or can be used, possibly in combination with other information, to derive an answer or perform the task. It is *pertinent* with respect to a user with a given purpose if, in addition, it gives just the information needed; is compatible with the user's background and cognitive style so he can apply the information gained; and is authoritative. It is *novel* if it adds to the user's knowledge.

IV. Material and Method

Analogously, a soccer player is topically relevant for a team if her abilities and playing style fit the team strategy, pertinent if she is compatible with the coach, and novel if the team is missing a player in her position. Utility might be measured in monetary terms: "How much is is it worth to the user to have found this document?" "How much is this player worth to us?" "How much did we save by finding this software?" In the literature, the term "relevance" is used imprecisely; it can mean utility or topical relevance or pertinence. Many IR systems focus on finding topically relevant documents, leaving further selection to the user. Relevance is a matter of degree; some documents are highly relevant and indispensable for the user's tasks; others contribute just a little bit and could be missed without much harm (see ranked retrieval in the section on *Matching*). From relevance assessments measures of retrieval performance can be computed such as:
Recall (R),

$$R = \frac{RICR}{ARI} \quad (1)$$

Also discrimination DC,

$$DC = \frac{IICR}{AII} \quad (2)$$

Precision can be written as:

$$P = \frac{RIR}{AIR} \quad (3)$$

Where: RICR: relevant items correctly retrieved, ARI: all relevant items in the collection, IICR: irrelevant items correctly rejected, AII: all irrelevant items in the collection, RIR: relevant items retrieved, AIR: all items retrieved.

Evaluation studies commonly use recall and precision or a combination; whether these are the best measures is debatable. With low precision, the user must look at several irrelevant documents for every relevant document found. More sophisticated measures consider the gain from a relevant document and the expense incurred by having to examine an irrelevant document. For ranked retrieval, performance measures are more complex. All of these measures are based on assessing each document on its own, rather than considering the usefulness of the retrieved set as a whole; for example, many relevant documents that merely duplicate the same information just waste the user's time, so retrieving fewer relevant documents would be better.

V. How Information Retrieval Systems Work

IR is a component of an information system. An information system must make sure that everybody it is meant to serve has the information needed to accomplish tasks, solve problems, and make decisions, no matter where that information is available. To this end, an information system must (1) actively find out what users need, (2) acquire documents (or computer programs, or products, or data items, and so on), resulting in a collection, and (3) match documents with needs.

VI. Results

In this work the total number of medical images in some collection is 1000 image, and the relevant items correctly retrieved are in 9 trials are respectively (100, 200, 300, 400, 500, 600, 700, 800, and, 900) then Recall- RICR relationship can be represented as in figure (1).

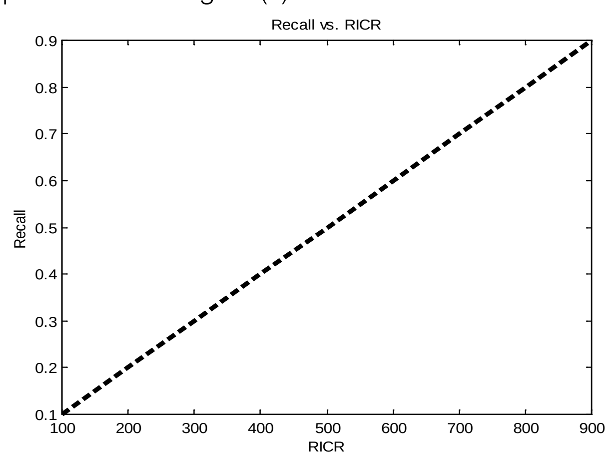

Figure 1 : Recall vs. RICR

Also discrimination DC varies linearly with rejected items for the same package of 1000 medical images. The precision of the system as in [3] can be reaching to 80%.

VII. Discussion

It is obvious that the recall and precision of the image system is linearly depends on RICR, also the proportionality between such values is fully with about 80% .

VIII. Conclusions

Number of retrieved images from huge total number of medical images in some hospital determine

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the systems' recall, discrimination, and precision of the retrieval information system.

References Références Referencias

1. [C. Weidong 2001] F. Dagan, F. Roger: Web-Based Digital Medical Images, IEEE Computer Graphics and Applications.
2. [M. Johan2007] Tristan GLATARD, Diane LINGRAND: Texture based Medical Image Indexing and Retrieval on Grids, MEDICAL IMAGING TECHNOLOGY Vol.25 No.5 November 2007
3. [M. Johan2004] B. Vincent, M. Isabelle: Medical image databases content-based queries partitioning on a grid, MEDIGRID, French ministry for Reseach ACI-GRID project. http://www.creatis.insa-lyon.fr/MEDIGRID/.
4. [O. Mohamad2001] Bruno Jedynak Mohamed Daoudi, 2001, Image Indexing & Retrieval Using Intermediate Features, MM'O/, Sept. 30-Oct. 5, 2001, Ottawa, Canada.
5. [Cosmin Spahiu, 2011]: TESTING THE PERFORMANCES OF A MULTIMEDIA DATABASE SYSTEM" International Journal of Computer Science and Applications, Vol. 8, No. 1, pp. 123-135.
6. [SWETA 2006] D. ALINA: Strategies for Working with Digital Medical Images Proceedings of the 39th Hawaii International Conference on System Sciences – 2006.

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Fast Implementation of Lifting Based DWT Architecture for Image Compression

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Abstract - Technological growth in semiconductor industry have led to unprecedented demand for faster, area efficient and low power VLSI circuits for complex image processing applications. DWT-IDWT is one of the most popular IP that is used for image transformation. In this work, a high speed, low power DWT/IDWT architecture is designed and implemented on ASIC using 130nm Technology. 2D DWT architecture based on lifting scheme architecture uses multipliers and adders, thus consuming power. This paper addresses power reduction in multiplier by proposing a modified algorithm for BZFAD multiplier. The proposed BZFAD multiplier is 65% faster and occupies 44% less area compared with the generic multipliers. The DWT architecture designed based on modified BZFAD multiplier achieves 35% less power reduction and operates at frequency of 200MHz with latency of 1536 clock cycles for 512x512 image. The developed DWT can be used as an IP for VLSI implementation.

Keywords : DWT, Image compression, BZFAD multiplier, FPGA, Lifting scheme.

GJCST-F Classification: I.4.2

FAST IMPLEMENTATION OF LIFTING BASED DWT ARCHITECTURE FOR IMAGE COMPRESSION

Strictly as per the compliance and regulations of:

Fast Implementation of Lifting Based DWT Architecture for Image Compression

M. Nagabushanam [α] & S. Ramachandran [σ]

Abstract - Technological growth in semiconductor industry have led to unprecedented demand for faster, area efficient and low power VLSI circuits for complex image processing applications. DWT-IDWT is one of the most popular IP that is used for image transformation. In this work, a high speed, low power DWT/IDWT architecture is designed and implemented on ASIC using 130nm Technology. 2D DWT architecture based on lifting scheme architecture uses multipliers and adders, thus consuming power. This paper addresses power reduction in multiplier by proposing a modified algorithm for BZFAD multiplier. The proposed BZFAD multiplier is 65% faster and occupies 44% less area compared with the generic multipliers. The DWT architecture designed based on modified BZFAD multiplier achieves 35% less power reduction and operates at frequency of 200MHz with latency of 1536 clock cycles for 512x512 image. The developed DWT can be used as an IP for VLSI implementation.

Keywords : DWT, Image compression, BZFAD multiplier, FPGA, Lifting scheme.

I. Introduction

The wavelet transformation is a widely used technique for image processing applications. Unlike traditional transforms such as the Fast Fourier Transform (FFT) and Discrete Cosine Transform (DCT), the Discrete Wavelet Transform (DWT) holds both time and frequency information, based on a multi-resolution analysis framework. This facilitates improved quality of reconstructed picture for the same compression than is possible by other transforms. In order to implement real time Codecs based on DWT, it needs to be targeted on a fast device. Field Programmable Gate Array (FPGA) implementation of DWT results in higher processing speed and lower costs when compared to other implementations such as PCs, ARM processors, DSPs etc. The Discrete wavelet transform is therefore increasingly used for image coding [1-4]. This is because the DWT can decompose the signals into different sub-bands with both time and frequency information and facilitate to arrive a high compression ratio [5]. It supports features like progressive image transmission (by quality, by resolution), ease of compressed image manipulation, region of interest coding, etc. The JPEG 2000 incorporates the DWT into its standard [6]. Recently several VLSI architectures have been proposed to realize single chip designs for DWT [7-10]. Traditionally, such algorithms were implemented using programmable DSP chips for low-rate applications or VLSI application specific integrated circuits (ASICs) for higher rates. To perform the convolution, we require a fast multiplier which is crucial in making the operations efficient.

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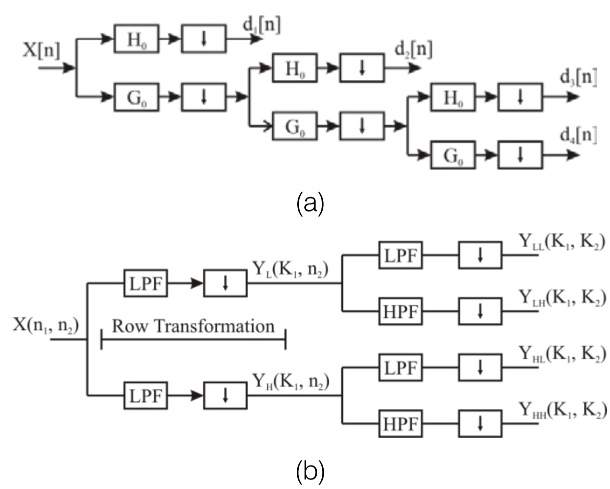
II. Lifting Based DWT Scheme

Fig. 1a and Fig. 1b represent the top level architecture for 1D DWT. Input X is decomposed into multiple sub bands of low frequency and high frequency components to extract the detailed parameters from X using multiple stages of low pass and high pass filters. The sub band filters are symmetric and satisfy orthogonal property. For an input being image, the two 1D DWT computations are carried out in the horizontal and vertical directions to compute the two level decomposition. The inverse DWT process combines the decomposed image sub bands to original signal; the reconstructions is possible due to the symmetric property and inverse property of low pass and high pass filter coefficients.



a 1D b 2D

Figure 1 : Image Decomposition

Input x (n_1, n_2) is decomposed to four sub-components Y_{LL}, Y_{LH}, Y_{HL} and Y_{HH}. This results in a one level decomposition. The Y_{LL} sub-band component is further processed and is decomposed to another four sub-band components thus forming two level

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decomposition. This process is continued as per the design requirements till the requisite quality is obtained. Every stage of DWT requires LPF and HPF filters with down sampling by 2. Lifting based DWT computation is widely being adopted for image decomposition. In this work, we propose a modified architecture based on BZFAD [11] multiplier to realize the lifting based DWT.

Lifting scheme is one of the techniques that is used to realize DWT architecture. Lifting scheme is used in order to reduce the no of operations to be performed to half and filters can be decomposed into steps in lifting scheme. The memory required and also computation is less in case of lifting scheme. The implementation of the algorithm is fast and inverse transform is also simple in this method. The Fig. 2.shows the block diagram for lifting scheme [12].

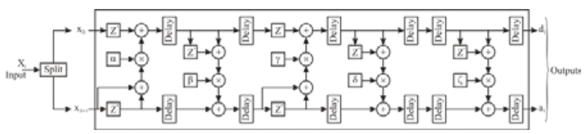

Figure 2 : Lifting scheme for 1D-DWT 9/7 filter

The z^{-1} blocks are for delay, α, β, γ, δ, ζ are the lifting coefficients and the shaded blocks are registers.9/7 filter has been used for implementation which requires four steps for lifting and one step for scaling. The input signal is x_i is split into two parts even part x_{2i} and odd part x_{2i+1} then the first step of lifting is performed given by the equations [13]:

$$d_i^1 = \alpha\,(x_{2i} + x_{2i+2}) + x_{2i+1} \qquad (1)$$

$$a_i^1 = \beta\,(d_i^1 + d_{i-1}^1) + x_{2i} \qquad (2)$$

The first equation is predict P1 and second equation is update U1.Then the second lifting step is performed which gives [13]:

$$d_i^2 = \gamma\,(a_i^1 + a_{i+1}^1) + d_i^1 \qquad (3)$$

$$a_i^2 = \delta\,(d_i^2 + d_{i-1}^2) + a_i^1 \qquad (4)$$

The third equation is predict P2 and fourth equation is update U2.Then scaling is performed and the following equations are obtained [13]:

$$a_i = \zeta\, a_i^2 = G_1 \qquad (5)$$

$$d_i = d_i^2/\zeta = G_2 \qquad (6)$$

The equations 5 and 6 are scale G_1 and G_2 respectively. The predict step helps determine the correlation between the sets of data and predicts even data samples from odd. These samples are used in the update step for updating the present phase. Some of the properties of the original input data can be maintained in the reduced set also by construction of a new operator using the update step. The lifting coefficients have constant values of -1.58613, -0.0529, 0.882911, 0.44350, -1.1496 for α, β, γ, δ, ζ respectively. By observation of the above equations, computing the final coefficients requires 6 steps. Data travels in sequence from stage 1 to stage 6, this introduces a delay of 6 stages. To speed up the process of computation, modified lifting scheme is proposed and realized.

III. Arithmetic Building Blocks for Lifting Scheme Implementation

High–speed multiplication has always been a fundamental requirement of high performance systems. Multiplier structure is one of the processing element consumes the maximum area and power and also constitutes delay. Therefore there is a need for high-speed architectures for N-bit multipliers with optimized area, speed and power. Multipliers are made up of adders, to reduce the Partial Product Reduction logic delay and regularize the layout. To improve regularity and compact layout, regularly structured tree with recurring blocks and rectangular-styled tree by folding are proposed at the expense of more complicated interconnects[14]. The present work focuses on multiplier design for low power applications such as DWT by rapidly reducing the partial product rows by identifying the critical paths and signal races in the multiplier. In other words, the goals have been to optimize the speed, area and power of the multiplier that form the major block in lifting based DWT.

a) Shift and Add Multiplier

In shift and add based multiplier logic, the multiplicand (A) is multiplied by multiplier (B). If the register A and B storing multiplicand and multiplier respectively is of N bit, the shift and add multiplier logic requires two N bit registers, and an N bit adder and N+1 accumulator. It also requires a N- bit counter to control the number of addition operation. In shift and add logic, the LSB bit of multiplier is checked for 1 or 0, if the LSB bit is 0, then the accumulator is shifted right by 1-position. If the LSB bit is 1 then the multiplicand is added with the accumulator content and the accumulator is shifted right by one bit position. The counter is decremented for every operation; the addition is performed until the counter is set to zero, which is indicated by the signal Ready. The multiplied product available in the accumulator of N clock cycles is the final output. Figure 3 below shows the top level block diagram of shift and add logic.

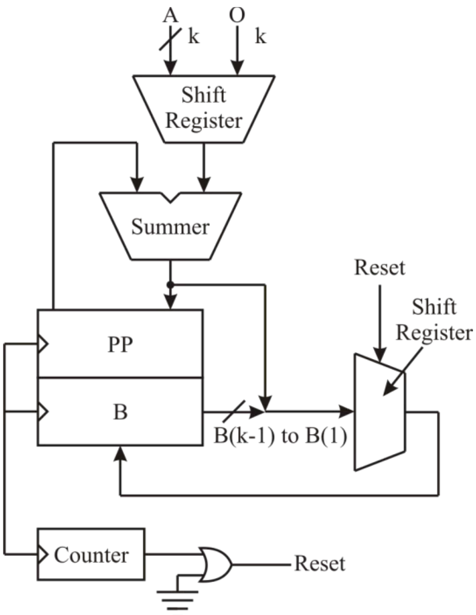

Fig. 3 : The Architecture of the Conventional Shift-and-Add Multiplier

IV. Bz-Fad Multiplier

As discussed in shift and add logic, if the LSB position is 1 then the accumulator is added with the multiplicand. If the accumulator contains more number of 1s, the adder has to add the 1 and this triggers the Full adder block within the adder. As we know that the power dissipation is due to switching activity of input lines, when ever the input or output changes, the power is switched from Vdd to Vss, thus contributing power dissipation. In order to reduce power dissipation, it is requried to reduce switching activity in the I/O lines. BZ-FAD [23] logic based multiplier reduces the switching activity and thus reduces power dissipation. In shift and logic for every operation the counter keeps track of number of cycles and thus controls the multiplication operation. In a binary counter, we know that the output bit change occurs in more than one bit, for example if the counter output is 2 and is changing to 3, there are two bit change occurring. This causes switching activity, and thus can be reduced by replacing the binary counter by ring counter. In a ring counter, at any given point of time only one bit change occurs, thus reducing switching activity and power dissipation. Another major source of power dissipation in shift and add logic is, for every bit 0 of the multiplier a shift operation is performed, thus all the bits in the accumulator are shifted by one bit position, this also introduces switching and thus power dissipation. In BZ-FAD logic, if the LSB bit is 0, then the shift operation is bypassed and a zero is introduced at the MSB, thus there is no shifting of accumulator content. In other words, if the LSB is zero, the accumulator is directly fed into the adder and there is no addition, but a zero is introduced by the control logic which is like right shift operation. The architecture of this multiplier is shown in Figure 4.

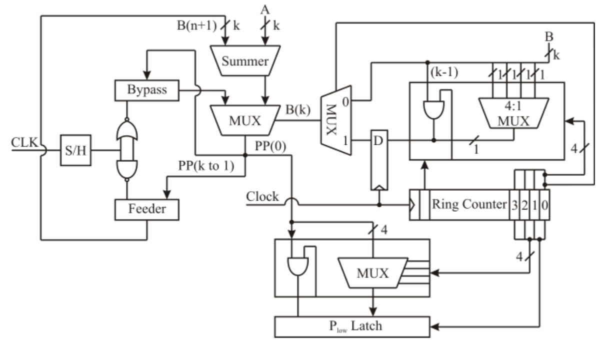

Fig. 4 : Low power multiplier architecture [16]

As the BZFAD, the control activity of ring counter, latch and bypass logic is realized using NMOS transistors, this introduces delay. The parasitic capacitance of NMOS transistors also increases the load capacitance and thus increases power dissipation. In order to reduce power dissipation we have replaced the transistor logic by MUX logic that have been designed to have ideal fanin and fanout capacitances. With MUX based logic the control signals can be suitably controlled to reduces switching activity as they are enabled only when required, based on the inputs derived from ring counter. However, the design requires more number of transistors and thus increases the chip area. We have also used the ripple carry adder which has the least average transition per addition among the look ahead, carry skip, carry-select and conditional sum adders to reduce power dissipation. Various multipliers are modeled in HDL and are analyzed for their performances and the results are tabulated for comparison. Next section discusses the comparison results of multiplier algorithms.

a) Comparison of Results

In this section, comparison of power, area for different types of multiplier with modified multiplier (BZ-FAD) is discussed. The results reveal that the modified BZ-FAD multiplier may be considered as a very low-power, yet highly area efficient multiplier.

b) Power Comparison

Table 1 : Power comparison of proposed multiplier with other multipliers

Multipliers	Total Dynamic power (w)	Cell Internal Power (µw)	Net Switching Power	Cell Leakage power (µw)
Modified BZ-FAD Multiplier	126	91.02	21.2	13.78
Shift and Add Multiplier	194	166.9	15.2	11.9
Booth Multiplier	379.12	295.62	62.2	21.3
Array Multiplier	231.5	145.4	66.3	19.8
Wallace Tree Multiplier	289.9	195.9	76.9	17.1

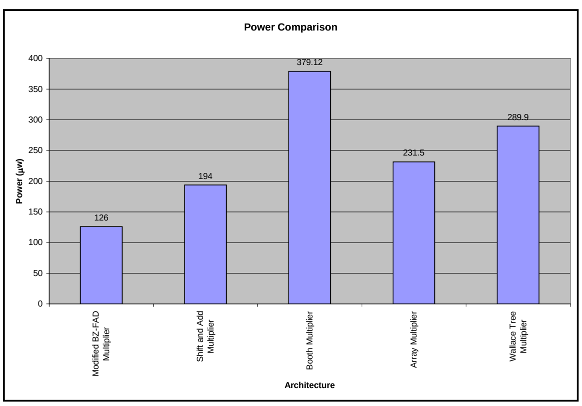

Fig. 5 : Power comparison of multipliers

As comparison, the power consumption of the multipliers for normally distributed input data are reported in Table 4.. As seen in Fig 5, the BZ-FAD multiplier consumes 33% lower power compared to the conventional multiplier. Finally, The results reveal that the BZ-FAD multiplier may be considered as a very low-power, yet highly area efficient multiplier.

c) Area Comparison

Table 2 : Area comparison of proposed multiplier with other multipliers [17,19]

Multipliers	Total Cell Area (µm2)	Number of Ports	Number of nets	Number of cells	Number of References
BZ-FAD Multiplier	2479.90	35	133	74	43
Shift and Add Multiplier	1726.25	35	99	43	12
Booth Multiplier	4459.06	34	233	163	32
Array Multiplier	3213.27	34	228	156	66
Wallace Tree Multiplier	3476.27	34	241	160	67

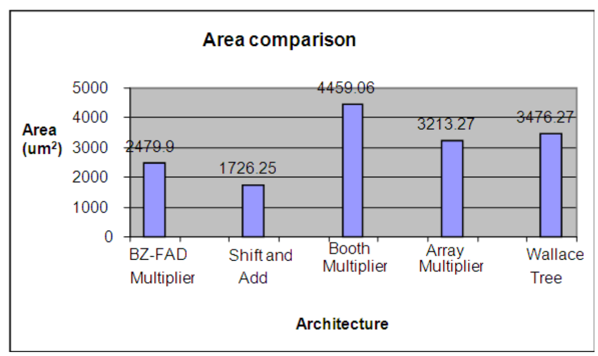

Fig. 6 : Area comparison of multipliers

In terms of the area, the proposed technique has some area overhead compared to the conventional shift-and-add multiplier as shown in Fig 6 and Table 2. Comparison between Fig 4 and Fig 3 reveals that M1, M2 and the ring counter are responsible for additional area in the proposed architecture. The area overheads of the ring counter and multiplexers *M1* and *M2* scale up linearly with the input data width. This leads to a small increase in the leakage power which, as the results reveal, is less than the overall power reduction. The leakage power of the 8-bit BZFAD architecture is about 11% more than that of the conventional architecture but the contribution of the leakage power in these multipliers is less than 3% of the total power for the technology used in this work. Finally, note that since the critical paths for both architectures are the same neither of the two architectures has a speed advantage over the other.

V. Discrete Wavelet Transform and Inverse Discrete Wavelet Transform Implementation

The discrete wavelet transform (DWT) is being increasingly used for image coding. This is due to the fact that DWT supports features like progressive image transmission (by quality, by resolution), ease of compressed image manipulation, region of interest coding, etc. DWT has traditionally been implemented by convolution. Such an implementation demands both a large number of computations and a large storage features that are not desirable for either high-speed or low-power applications. Recently, a lifting-based scheme that often requires far fewer computations has been proposed for the DWT [20, 21, 22]. The main feature of the lifting based DWT scheme is to break up the high pass and low pass filters into a sequence of upper and lower triangular matrices and convert the filter implementation into banded matrix multiplications. Such a scheme has several advantages, including "in-place" computation of the DWT, integer-to-integer wavelet transform (IWT), symmetric forward and inverse transform, etc. Therefore, it comes as no surprise that lifting has been chosen in the upcoming.

The proposed architecture computes multilevel DWT for both the forward and the inverse transforms one level at a time, in a row-column fashion. There are two row processors to compute along the rows and two column processors to compute along the columns. While this arrangement is suitable or filters that require two banded-matrix multiplications filters that require four banded-matrix multiplications require all four processors to compute along the rows or along the columns. The outputs generated by the row and column processors (that are used for further computations) are stored in memory modules.

The memory modules are divided into multiple banks to accommodate high computational bandwidth requirements. The proposed architecture is an extension of the architecture for the forward transform that was presented. A number of architectures have been proposed for calculation of the convolution-based DWT. The architectures are mostly folded and can be broadly classified into serial architectures (where the inputs are supplied to the filters in a serial manner) and parallel architectures (where the inputs are supplied to the filters in a parallel manner).

Recently, a methodology for implementing lifting-based DWT thatreduces the memoryrequirements and communication between the processors, when the image isbroken up into blocks. For a system that consists of the lifting-based DWT transform followed by an embedded zero-tree algorithm, a new interleaving scheme that reduces the number of memory accesses has been proposed. Finally, a lifting-based DWT architecture capable of performing filters with one lifting step, i.e., one predict and one update step. The outputs are generated in an interleaved fashion.

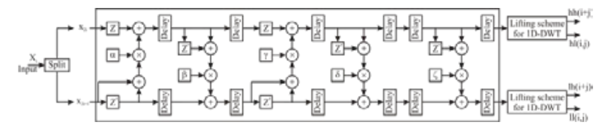

Figure 2.4 : 2-D Lifting-based DWT

The equations of the 1-D DWT based on lifting scheme is represented as

$$h(i) = x(2i+1)+\alpha(x(2i)+x(2i+2)) \quad (7)$$

$$l(i) = x(2i)+\beta(h(i)+h(i-1)) \quad (8)$$

The 2-D DWT is a multilevel decomposition technique, that decomposes into four sub bands such as *hh*, *hl*, *lh* and *ll*. The mathematical formulas of 2-D DWT are defined as follows:

$$hh(i,j) = h(2i+1,j) + \alpha\,(h(2i,j) + h(2i+2,j)) \quad (9)$$

$$hl(i,j) = h(2i,j) + \beta\,(hh(i,j) + hh(i-1,j)) \quad (10)$$

$$lh(i,j) = l(2i+1,j) + \alpha\,(l(2i,j) + l(2i+2,j)) \quad (11)$$

$$ll(i,j) = l(2i,j) + \beta\,(lh(i,j) + lh(i-1,j)) \quad (12)$$

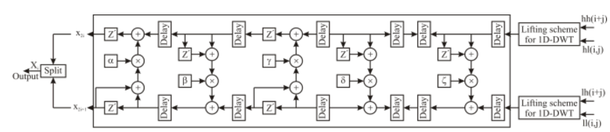

Figure 2.5 : 2-D Lifting based IDWT

The mathematical formulas of 2-D IDWT as defined as follows

$$l(2i,j) = ll(i,j)-\beta(lh(i,j)+lh(i-1,j)) \quad (13)$$

$$l(2i+1,j) = lh(i,j)-\alpha(L(2i,j)+l(2i+2,j)) \quad (14)$$

$$h(2i,j) = hl(i,j)-\beta(hh(i,j)+hh(i-1,j)) \quad (15)$$

$$h(2i+1,j) = hh(i,j)-\alpha(h(2i,j)+h(2i+2,j)) \quad (16)$$

$$x(i,2j) = l(i,j)-\beta(h(i,j)+h(i,j-1)) \quad (17)$$

$$x(i,2j+1) = h(i,j)-\alpha(x(i,2j)+x(i,2j+2)) \quad (18)$$

Different Values at different stages of DWT Synthesis

Report	Without BZ-FAD (Shift and add multiplier)	With BZ-FAD multiplier
Area (sq.mm)	20654	21984
Power (µw)	572	367

The Discrete wavelet transforms and inverse discrete wavelet transform operates at a maximum clock frequency of 200MHz. the discrete wavelet transforms and inverse discrete wavelet transform is synthesized by using design compiler. The design of DWT and IDWT is checked design for testability. Every time checked

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timing reports and the power report is taken from the primetime. The architectures for DWT and IDWT perform compression and decompression in $(4N^2(1-4-j)+9N)/6$ computation time. The total power consumption of the DWT/IDWT processor is ~0.367mW. The area of the designed architecture in 0.13 micron technology is 112 X 114 um square, and the frequency of operation is 200 MHz for discrete wavelet transform.

VI. Conclusion

In this work low-power architecture for shift-and-add multipliers is proposed and implemented. The conventional architecture has been modified by removing the shift operation of the B register (in $A \times B$), direct feeding of A to the adder, bypassing the adder whenever possible, use of a ring counter instead of the binary counter, and removal of the partial product shifter. The BZ-FAD multiplier is further modified using multiplexers and XOR gates, the modified multiplier is modeled and implemented using 130nm technology. The modified multiplier is used in constructing lifting based DWT/IDWT architecture. The DWT/IDWT architecture is modeled and synthesized using TSMC libraries. The BZ-FAD multiplier based DWT/IDWT architecture reduces power dissipation by 30% and operates at 200 MHz. The adders in the lifting based DWT/IDWT can be further improved by replacing the adders by low power adders.

References Références Referencias

1. Tze-Yun Sung, Hsi-Chin Hsin Yaw-Shih Shieh and Chun-Wang Yu, "Low-Power Multiplierless 2-D DWT and IDWT Architectures Using 4-tap Daubechies Filters", Seventh International Conference on Parallel and Distributed Computing, Applications and Technologies, December 2006.
2. Abdullah AL Muhit, Md. Shabiul Islam and Masuri Othman, "VLSI Implementation of Discrete Wavelet Transform (DWT) for Image Compression", 2nd International Conference on Autonomous Robots and Agents, 13-15 December 2004.
3. Motra A. S. Bora P.K. and Chakrabarti I. "An efficient hardware implementation of DWT and IDWT", Conference on Convergent Technologies for Asia-Pacific Region, 15-17 October 2003.
4. Yun-Nan Chang and Yan-Sheng Li, "Design of highly efficient VLSI architectures for 2-D DWT and 2-D IDWT", IEEE Workshop on Signal Processing Systems, 26-28 September 2001.
5. Keshab K. Parhi and Takao Nishitani, "VLSI architectures for discrete wavelet transforms", IEEE Transactions on Very Large Scale Integration (VLSI) Systems, Vol. 1, No. 2, pp. 191-202, June 1993.
6. David S. Taubman, Michael W. Marcellin, "JPEG 2000 – Image compression, fundamentals, standards and practice", Kluwer academic publishers, Second Edition, 2002.
7. Simone Borgio, DavideBosisio, FabrizioFerrandi, MatteoMonchiero, Marco D. Santambrogio, Donatella Sciuto and AntoninoTumeo, "Hardware DWT accelerator for MultiProcessor System-on-Chip on FPGA", Embedded Computer Systems: Architectures, Modeling and Simulation, 2006. IC-SAMOS 2006, July 2006, pp. 107 - 114.
8. Mel Tsai, BDTI, "Designing Low-Power Signal Processing Systems", http://www.dspdesignline.com/showArticle.jhtml?articleID=187002923.
9. Tze-Yun, **"Low-power and high-performance 2-D DWT and IDWT architectures based on 4-tap Daubechies filters", Proceedings of the 7th WSEAS International Conference on Multimedia Systems and Signal Processing,** Hangzhou, China, pp. 50-55, 2007.
10. S. Baloch, I. Ahmed, T. Arslan, A. Stoica, "Low power domain-specific reconfigurable array for discrete wavelet transforms targeting multimedia applications, "**International Conference on Field Programmable Logic and Applications**", pp. 618-621, International Conference on Field Programmable Logic and Applications, 2005.
11. Kuan-Hung Chen and Yuan-Sun Chu, "A Low-Power Multiplier with the Spurious Power Suppression Technique," IEEE Trans. On Very Large Scale Integration (VLSI) Systems, vol. 15, no. 7, July 2007, pp. 846-850.
12. Kishore Andra, ChaitaliChakrabarti and TinkuAcharya, "A VLSI Architecture for Lifting-Based Forward and Inverse Wavelet Transform" IEEE Transaction on signal processing , VOL. 50, NO. 4, pp.966-977, April 2002.
13. Movva S and Srinivasan S "A novel architecture for lifting-based discrete wavelet transform for JPEG2000 standard suitable for VLSI Implementation" VLSI Design, 2003. Proceedings. 16th International Conference On 4-8 Jan. 2003 Page(s): 202 – 207.
14. DusanSuvakovic, C. Andre, Salama "A Pipelined Multiply-Accumulate Unit Design for Energy Recovery DSP Systems" IEEE International Symposium on Circuits and Systems, May 28-31, 2000.
15. Jung- Yup Kang, Jean-Luc Gaudiot, "*A Simple High-Speed Multiplier Design*" IEEE Transactions on computers, Vol 55, No 10, October 2006, pp 1253 – 1258.
16. Zhijun Huang, Milos D. Ercegovac, "*High-performance Low-power Left-to-Right Array Multiplier Design*" IEEE Transactions on computers, Vol 54, No.3, Mar 2005, pp 272 – 283.
17. C. S. Wallace, "*A Suggestion for a Fast Multiplier*", IEEE Trans. computers, vol 13, no. 2, pp 14 – 17, 1964.

18. Vojin G. Oklobzija, Bart R. Zaydel, Hoang Q. Dao, Sanu Mathew and Ram Krishnamurthy, "*Comparison of high-performance VLSI adders in the energy-delay space*", IEEE Trans. VLSI Systems, vol. 13, no. 6, pp. 754-758, June 2005.
19. J-Y Kang and J-L Gaudiot, "A Fast and Well structured Multiplier," EUROMICRO Symp. Digital System Design, pp.508 – 515, Aug 2004.
20. Nagabushanam,M., Cyril prasanna Raj, and Ramachandran,S. 'ModifiedVLSI implementation of DA-DWT for image compression', International Journal of Signal and Imaging Systems Engineering, (to be published by inderscience)Vol. x, No. x, pp.xxx–xxx.
21. Nagabushanam,M., Cyril prasanna Raj, and Ramachandran,S.(2009),'Design and implementation of parallel and pipelined Distributive arithmetic based discrete wavelet transform IP core', EJSR International Journal, Vol. 35.No. 3, pp.379–392.
22. Nagabushanam,M., Cyril prasanna Raj, and Ramachandran,S. (2011), 'Design and FPGA implementation of Modified Distributive arithmetic based DWT-IDWT processor for image compression', International Conference on Communication and Signal Processing, February, NIT, Calicut, India, p.69.
23. M. Mottaghi-Dastjerdi, A. Afzali-Kusha, and M. Pedram BZ-FAD: A Low-Power Low-Area Multiplier Based on Shift-and-Add Architecture, IEEE Transactions on Very large Scale Integration (VLSI)systems, VOL. 17, no.2, feb 2009.

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30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page

- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.
- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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