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Removal of Occlusion for Abstraction of Class-Room Videos

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Abstract: ***In this paper, we examine the case of occlusion removal from a class-room video in a remote class application. Written text on writing-board in sequence of video frames is occluded by a human subject. Our goal is to remove the occlusion, in our case it is human subject. As the human subject moves across the writing-board, he or she will occlude different parts or regions of the writing-board. The region of occlusion can be replaced by the contents of the frame in which the same region not occluded by the human subject. Thus, it requires to segment each of the frames into two types of region namely occluded and unoccluded. The frames are segmented based on a supervised statistical analysis. For decreasing the computation efficiency of proposed segmentation method, a multi-resolution analysis based on haar wavelet is implemented. In order to fill gaps in the output of the segmentation method, certain morphological operation are implemented which gives the final segmented regions in each frame. Finally, the human occlusion is removed based on the segmentation results by appropriate replacement of the content from the other frames.***

Index Terms**:** ***Occlusion, Wavelet transformation, Statistical method.***

I. INTRODUCTION

Now a day's many academic and industrial institutes impart knowledge by delivering live multi-media contents in the class-room located at remote places from the institutions. Here we consider a case of writing-board class-room teaching where the occlusion of the writing-board by the writer or the teacher is considered as an undesirable effect for the remote-class scenario. It is really a challenging problem how to handle this type of occlusion and also maintain the contents written on the writing-board.

Here we proposed method for removal of occlusion from class-room video in remote class application. This method begins with video as input which has human subject as occlusion. This method processes the video and gives frame (image) which has written text of whole video without human subject, as output. There are many techniques for handling occlusion in different system. Here we use automatic removal of occlusion from minimum number of images method for removing occlusion [1]. In automatic removal of occlusion from minimum number of images, occlusion is removed in current frame using reference of previous frame which is unoccluded at same location.

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The goal of the project is to remove occlusion of the writing-board due to the writer and to get the complete picture of the contents present on the writing-board. After the proposed pre-processing steps to the input video it should produce an output image that has all present contents on the writing-board without human subject

II. RELATED WORK

In taking a picture of some famous scene, many people would have experienced the difficulty caused by the passers-by that come between the scene and the camera [1]. As the person moves in and out of the scene, it will become difficult to take a picture without occlusion. This problem has been addressed in context of a specific application, Automatic occlusion removal from minimum number of images [1]. This method is presented in [1] removes occlusion from an image. This approach is different from the region filing method like in-painting. It removes occlusion using the same images taken at various time. For occlusion removal in the current frame, we calculate the same region in other frame which is not occluded and then map it to the occluded region of the current frame.

There are several methods for detecting or removing an occlusion. It is application dependent, whether you want to detect occlusion or remove it. Occlusion is a very complex problem in many systems. Due to occlusion, the system may lose the target being tracked or lose the scene you are watching. Here, the algorithm suggests that the occlusion be detected before it occurs, or partially occurs. This method is given in [4]. Other occlusion detection methods are described in [5].

Occlusion removal method is described in Removal of occlusion from single images [6] Here, occlusion occurs near depth discontinuities when the foreground object is severely out of focus. This paper models these partial occlusions using matting. The main concentration of this paper is a method for removing image contribution of the foreground occluder in the region of partial occlusion. This improves the visibility of background scene. Occlusion processing method is described in [7], which uses Improved Object Contour Extraction Algorithm by Neighboring edge Search and MER in Simulation.

III. PROPOSED ALGORITHM

A. Occlusion Consideration

We assume that occlusions generally occur because of a person or an object moving in front of the desired scene. We normally define occlusion as any object which comes between scene being seen and person or object (camera) that sees the scene. It is a connected set. An occlusion is created by two types of objects, stationary and moving. Examples of stationary objects are a poll, a building etc., and an example of a moving object is a vehicle. An occlusion created by an object is regular in shape. While occlusions created by a person has an irregular shape. In our case, occlusion is created by a person (professor), which is irregular in shape. It is very difficult to detect the boundary of an irregular shape compared to a regular shape.

B. Wavelets

Based on wavelet decomposition model, the original can be divided into low-frequency components and high-frequency components. After two dimensional decomposition of wavelet transform, original image can be divided into four frequency components, LL frequency-band, LH frequency-band, HL frequency-band and HH frequency-band. LL shows a smoothing image of the original image which contains most of the information of the original image. LH preserves the vertical component of the image. HL preserves the horizontal component of the image. HH preserves the diagonal component of the image. The process is shown in figure 1.

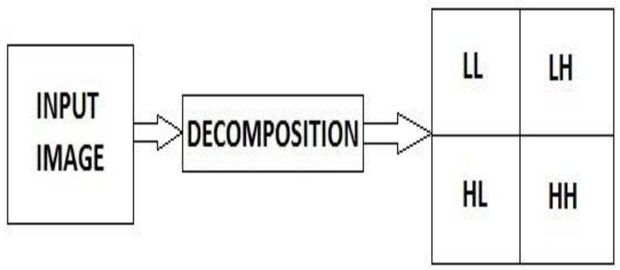

Figure1. Wavelet Decomposition Model

Figure-1 shows level-1 decomposition. We can decompose the result as we need. For example, to decompose at the next level (at level 2), decompose LL frequency band further into four frequency bands as describe above. Haar transformation can be used for decomposition.

Wavelets can be used effectively for image decomposition. The size of the image can be reduced in an effective manner to reduce the number of computations. For example, we can reduce the computation in detecting an edge [2 3].The location reference is preserved at every scale making the search very fast.

Wavelets are functions generated from one basis function called mother wavelet by scaling and translating in frequency domain. In 2D wavelets, we have a scaling function and three wavelets.

The scaling function:

$$\varphi^{2D} = \varphi(x)\varphi(y) \qquad (1)$$

The three wavelets:

$$\Psi_1^{2D}(x,y) = \varphi(x)\Psi(y) \qquad (2)$$

$$\Psi_2^{2D}(x,y) = \Psi(x)\varphi(y) \qquad (3)$$

$$\Psi_3^{2D}(x,y) = \Psi(x)\Psi(y) \qquad (4)$$

Where, φ and ψ indicate the scaling function and 1-D wavelet respectively.

C. Statistical Supervised Training

Here, we consider the case of class-room teaching scenario in which the occlusion is the human subject. So, we have two regions in a frame, one is the background and other is foreground which has an occlusion (human subject). Statistical supervised manual training is given to first frame for segmentation of above described regions. Tag pixels of region of background as 0 and tag pixels of region of human subject as 1.

D. Mean-variance Based Classification

For segmentation of regions of other frames, mean-variance based classification is applied. Having mean and variance of two segmented region of trained frame, one can classify two regions of other frames. If current frame's pixel intensity is closest to the region of background than tag that pixel as background, if not than tag that pixel as foreground (human subject).

E. Morphological Process For Filling Holes

Classified frames may have holes in foreground region, means in human subject. Because problem of falls detection occur in mean-variance based classification. By morphological processing holes can be filled.

Hole filling algorithm:

We start from forming an array X_0 of zeros (the same size as the array containing A), except at the locations in X_0 corresponding to the given point in each hole, which is set to one. Then, the following procedures point in each hole, which is set to one. Then, the following procedure fills all the holes with ones:

$$X_K = (X_{K-1} \oplus B) \cap A^C \qquad (5)$$

$K = 1, 2, 3….$

Where, B is the symmetric structuring element.

The algorithm terminates at the iteration step k if Xk = Xk-1. The set Xk then contains all the filled holes; the union of Xk and A contains all the filled holes and their boundaries.

F. Up sampling

Frames can be resized to its original resolution by nearest neighborhood method. Now pixels of human subject in current frame can be removed by mapping pixels of background region of previous frame at same location.

G. Proposed Algorithm

Input: Extracted video frames.

Output: Abstracted frame with written text content of whole video without human subject.

Steps of algorithm are given below:

Here we work at pixel level of the video frames. Tag 1 is assigned to the pixel with an occlusion, while tag 0 is assigned to the pixel without an occlusion. From step 2 to step 6,

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the algorithm is applied to LL frequency band of wavelet transformed frame.

Step 1: Apply Wavelet Transformation to video frames at the level you want.

Step 2: Apply statistical supervised manual training to the first frame to segment two regions, tag 0 to background regions, tag 1 to human subject (foreground).

Step 3: Calculate Mean and Variance of two regions of frame derived from step 2.

Step 4: Calculate threshold value for classify two regions of frames from first frame from analysis of histogram of that region.

Step 5: Apply statistical classification to other frames for classify two regions with reference to first frame which is manually trained.

Step 6: Apply morphological process to fill holes.

Step 7: Up sampling of frames with nearest neighbourhood method.

Step 8: Replace the pixel of the current frame with class tag 1(pixel with occlusion) from previous or past frame which has class tag 0(pixel without occlusion) at same location.

Step 9: Select resultant frame of step 8 as a previous frame and repeat step 8 until end of frame.

IV. FUTURE WORK

In future, we will implement these proposed algorithms and will strive to make algorithms as efficient as possible for better system performance. We implement our proposed algorithm on matlab.

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