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AN AUTOMATED MONITORING SYSTEM FOR TOURIST/SAFARI VEHICLES INSIDE SANCTUARY

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ABSTRACT

The proposed system will help to monitor and locate the position of vehicles inside sanctuary. It can also be used for rescue measures inside sanctuary as there is no other means of communication due to absence of mobile network in dense forest. The level of security is very crucial issue inside sanctuary and the problem of missing and getting trapped in problem is prime concern to the persons involved and affected. There is common problem of going on wrong way or some problem in vehicle. It becomes more severe at morning and night as the wild animal get active at this time. Getting help inside the sanctuary is very big issue as there is no way of communication due to absence of mobile or any other signals. Even it is more crucial to monitor inside dense forest. More than thousands of tourist per day visits a medium size sanctuary due to which it becomes more problematic to monitor each vehicle separately. Existing manual methods fail to provide enough level of security and work done to solve this problem is very minimal. Webcam based monitoring is a technology which is expected to replace traditional monitoring methods. The use of proposed system may provide tourist the peace of mind knowing that they are now more secure and safe inside sanctuary. An algorithm has been developed and result has been found satisfactory.

KEYWORDS: Object tracking and Detetion, Kalman Filter, Mean Shift Method.

One of the key research areas in image processing is face recognition. One of the common problems encountered in image segmentation is choosing a suitable approach for isolating different objects from the background. There are several research contributions in the area of face image segmentation and classification. In the present work we have attempted to implementation of various segmentation and classification approach as part of our work which can be find in few published research papers which could be seen in list of publications.

In the field of image processing a lot of work has been carried out for object detection and classification. And use of these classified objects is not restricted to a particular task or process. This work will use this object detection technique for surveillance of the tourist inside sanctuary. There is no doubt that web cam based monitoring is one of the most important and effective solutions for such applications. Some of the works done by researcher in this field are mentioned below.

Isaac Cohen et al. [1999] has proposed method relies on a graph representation of moving objects which allows to derives and maintain a dynamic template of each moving object by enforcing their temporal coherence.. Shireen Y. Elhabian et al. [2008] has made survey on many existing schemes in the literature of background removal, Surveying the common pre-processing algorithms used in different situations, presenting different background models and the most commonly used ways to update such models and how they can be initialized. Paresh M. Tank et al. [2012] has proposed a fast technique to extract moving object from background using MoG model and Haar Wavelet. In this technique before applying the MoG we down sample each video to acceptable resolution using Haar Wavelet Decomposition. Abhishek Kumar Chauhan et al. [2013] has discussed a video surveillance scenario with real time moving object detection and tracking. The detection of moving object is important in many tasks, such as video surveillance and moving object tracking. They try to review briefly research works on object and tracking in videos. The definition and tasks of object detection and tracking are first described and the important applications are mentioned. Mrinali M. Bhajibhakare et al [2013] has proposed the system which can be apply in home and business surveillance system to detect and track moving objects and also differentiate that, the detected objects are either vehicle or human beings. Kinjal A Joshi et al. [2012] has presented a survey of various techniques related to video surveillance system improving the security. In this work they focuses on detection of moving object in video surveillance system then tracking the detected object in the screen and also describe background subtraction with alpha, statistical method.

Chih-Hsien Hsia et al. has presented a new approach direct LL-mask Scheme (DLLBs) for the detection and tracking of moving object using a low resolution image. Jyoti J. Jadhav has presents the moving object detection and tracking using reference background subtraction. In this method the used static camera for video and first frame of video is directly consider as reference background frame and this frame is subtracted from current frame to detect moving object

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and then set threshold T value. Jacinto Nascimento et al. [2006] has propose novel methods to evaluate the performance of object detection algorithms in video sequences. This procedure allows us to highlight characteristics which are specified of the method being used.

Sri Lasshmi Gogulamudi et al. [2012] has proposed a new approach for detection and tracking of multiple objects in video surveillance system using particle filtering techniques and considering environments factors which results in high computational overhead and low tracking accuracy. Pranab kumar Dhar et al. [2012] has proposed an efficient moving object detection method using enhanced edge localization mechanism and gradient directional masking for video surveillance system. In the proposed system gradient map images are initially generated from the input and backgrounds images using a gradient operator.

The paper has been organized in the following manner -: section 3 proposes the mathematical formulations and analysis, section 4 describes the simulated results and discussions, section 5 gives the concluding remarks and further scope of the work. Finally the last section incorporates all the references been made for the completion of this work.

SOLUTION AND PROPOSED METHODOLOGY

The objective of this thesis is to investigate and develop a systematic approach for analysis of biometric security system using artificial neural network (ANN) and fuzzy logic within a single framework of biometrical study and analysis. The present work aims to analyze and discuss experimentally the aforesaid problem in the subsequent subsections.

Mathematical Analysis

Based on the assumption that the original image is additive with noise. To compute the approximate shape of the wavelet (that is, any real valued function of time possessing some structure), in a noisy image and also to estimate its time of occurrence, two methods are available, first one is a simple structural analysis and the second one is the template matching technique. For the detection of wavelets in noisy image, assume a class of wavelets, Si(t), I = 0,...N-1, all having some common structure. Based on this assumption that noise is additive, then the corrupted image has been modeled by the equation -:

$$X(m,n) = i(m,n) + G\, d(m,n) \quad (1)$$

Where, i(m,n) is the clean image, d(m,n) is the noise and G is the term for signal-to-noise ratio control. To de-noise this image, wavelet transform has been applied. Let the mother wavelet or basic wavelet be ψ(t), which yields to,

$$\psi(t) = \exp(j2\pi ft - t2/2) \quad (2)$$

Further as per the definition of continuous wavelet transform CWT (a,τ), the relation yields to,

$$CWT(a, \tau) = (1/\sqrt{a}) \int x(t)\, \psi\{(t-\tau)/a\}\, dt \quad (3)$$

The parameters obtained in equation (3) has been discretized, using discrete parameter wavelet transform, DPWT (m, n), by substituting a = aom, τ=nτ0aom. Thus equation (3) in discrete form results to equation (4),

$$DPWT(m, n) = 2\text{-}m/2\Sigma k\ \Sigma l\ x(k, l)\ \psi(2\text{-}m\ k - n) \quad (4)$$

where 'm' and 'n' are the integers, a0 and τ0 are the sampling intervals for 'a' and 'τ', x(k,l) is the enhanced image. The wavelet coefficient has been computed from equation (4) by substituting a0 = 2 and τ0 = 1. Further the enhanced image has been sampled at regular time interval 'T' to produce a sample sequence {i (mT, nT)}, for m = 0,1,2, M-1 and n=0,1,2,…N-1 of size M x N image. After employing discrete fourier transformation (DFT) method, it yields to the equation of the form,

$$I(u,v) = \sum_{m=0}^{m-1} \sum_{n=0}^{n-1} i(m,n) \exp(-j2\pi(um/M + vn/N)) \quad (5)$$

For u=0,1,2,…,M-1 and v = 0, 1, 2, ……..,N-1

In order to compute the magnitude and power spectrum along with phase angle, conversion from time domain to frequency domain has been done. Mathematically, this can be formulated as, Let R(u,v) and A(u,v) represent the real and imaginary components of I(u,v) respectively.The Fourier or Magnitude spectrum yields.

$$|I(u,v)| = [R2(u,v) + A2(u,v)]1/2 \quad (6)$$

The phase angle of the transform is defined as,

$$\varphi(u,v) = \tan\text{-}1[A(u,v)/R(u,v)] \quad (7)$$

The power spectrum is defined as the square of the magnitude spectrum. Thus squaring equation (6), it yields,

$$P(u,v) = |I(u,v)|2 = R2(u,v) + A2(u,v) \quad (8)$$

Due to squaring, the dynamic range of the values in the spectrum has been found very large. Thus to normalize this, logarithmic transformation has been applied in equation (6). Thus, it yields.

$$|I(u,v)|_{normalize} = \log(1 + |I(u,v)|) \quad (9)$$

The expectation value of the enhanced image has been computed and it yields to the relation,

$$E[I(u,v)] = 1/MN \sum_{u=0}^{M-1} \sum_{v=0}^{N-1} I(u,v) \quad (10)$$

where 'E' denotes expectation. The variance of the enhanced image has been computed by using the relation,

$$Var[I(u,v)] = E\{[I(u,v) - I'(u,v)]^2\} \quad (11)$$

The auto-covariance of an enhanced image has also been computed using the relation,

$$C_{xx}(u,v) = E\{[I(u,v) - I'(u,v)][I(u,v) - I'(u,v)]\} \quad (12)$$

Then the power spectrum density has been computed from equation (12),

$$P_E(f) = \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} (Cxx(u,v)W(m,n)\exp(-j2\pi f(m+n)) \quad (13)$$

where $C_{xx}(m,n)$ is the auto-covariance function with 'm' and 'n' samples and W(m,n) is the Blackman window function with 'm' and 'n' samples. The DCT has normal, separable and energy compaction property. Although DCT does not separate frequencies, it is a powerful signal de-correlator. It is a real-valued function and thus can be more efficiently in real-time operation. It is a technique that converts a spatial domain waveform into its constituent frequency components as represented by set coefficients. Most of the signal information tends to be concentrated in a low frequency component of the DCT. The data compression has been performed using discrete cosine transform (DCT), given below,

$$DCT_c(u,v) = \sum_{m=0}^{M-1} \sum_{n=0}^{N-1} I(m,n)\text{Cos}\,(2\pi T(m+n)/MN) \quad (14)$$

These variations has been studied and analyzed further for the improvement of the performance of the system in the present research work. Thus the mechanism of object detection and tracking has been adopted to justify the study and analysis of automatic monitoring system. As little amount of work has been done in this area, using soft-computing techniques, hence through the present research work, commendable and remarkable results have been obtained through the mechanism of image object detection and tracking using soft-computing techniques. In the present work ANN and FSR have been employed as soft-computing tools and results of developed algorithms is compared with Kalman Filter, Mean Shift Method. The present research work has been carried out in two different phases: modeling phase and simulation phase. The schematic workflow diagram for the modeling phase has been shown in the figure 1.

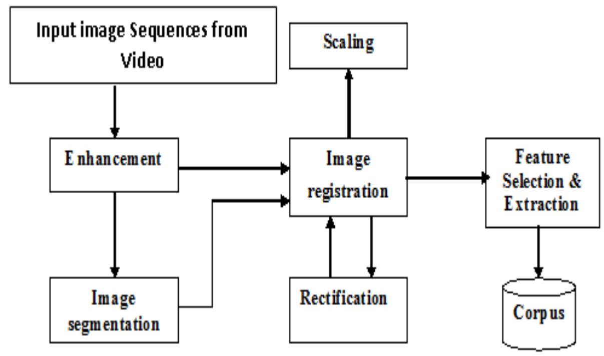

Figure 1: Schematic diagram for Modeling Phase

In the modeling phase as shown in the figure 1, first an input image is enhanced and compressed for the removal of distortion with loss-less information, second the object of interest is selected for cropping and trimming and hence image warping has been applied, later on at third, the trimmed image has been segmented for edge detection, fourth detection of the region of interest, fifth the relevant features have been extracted and sixth using artificial neural network the feature vectors have been utilized for framing a corpus or knowledge-based model called For Automatic monitoring system. In the simulation phase, the model has been utilized for simulating trained and test patterns. To summarize this simulation process first an unknown image sequence form vedio has been studied with proper enhancement, cropping, trimming, segmentation and detection and tracking. In the enhancement stage removal of noise from the image has been carried out. Later preprocessing stage has been applied for further compression, dilation, erosion and computation of connected components for segmentation. Hence detection of ROI has been done using known algorithms or methods. After detecting proper ROI post-processing stage has been carried out for feature extraction. Then relevant features have been extracted and hence compared with the knowledge-based model or corpus. Kalman filter is a recursive measurement process, it can run in real time which involves in a process of prediction and correction repeatedly till the predicted object path and original object path get coincided which results in tracking of the moving object.

Kalmal filter involves the following steps:

1) Prediction

2) Correction using the measurement

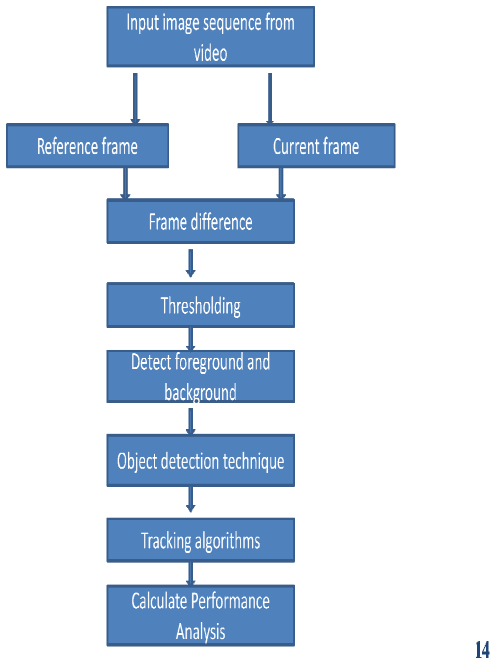

Figure 2: Workflow diagram of simulation phase

Mean shift is a non-parametric feature-space analysis technique for locating the maxima of a density function, a so-called mode-seeking algorithm

Mean shift is a procedure for locating the maxima of a density function given discrete data sampled from that function. It is useful for detecting the modes of this density.

Although the mean shift algorithm has been widely used in many applications, a rigid proof for the convergence of the algorithm using a general kernel in a high dimensional space is still missing. The convergence of the mean shift algorithm in one-dimension with a differentiable, convex, and strictly decreasing profile function showed by some researchers. However, the one-dimensional case has limited real world applications. Also, the convergence of the algorithm in higher dimensions with a finite number of the (or isolated) stationary points has been proved. However, a sufficient condition for a general kernel function to have finite (or isolated) stationary points has not been provided.

Proposed algorithms:-Algorithms for Automatic monitoring system

1. Read the input image sequence and hence convert into gray scale image
2. Perform filtering for the removal of noise from the image and select region of interest and also object of interest
3. Perform morphological image processing for thinning and thickening of the objects
4. Crop the image and extract features along with relevant parameters
5. Employ statistical methods of computing like cross-correlation and auto-correlation with deviation of neighboring pixels using 4-pair and 8-pair concepts of pixel pairing
6. Employ fuzzy-c means clustering method for the computation of different pattern of moving object. Hence compute the mean of the clusters.
7. Parameters in the form of corpus as a trained data set Plot the results and store the extracted.

RESULTS AND DISCUSSION

The present section of the paper describes the experimental results. The present work has been carried out in two phases: modeling and simulation. Modeling involves formation of corpus of vehicles and animals of century. In this process a known image sequence from video has to be fed as input. Then it has to be pre-processed for enhancement and segmentation. The enhancement is done for filtering any noise present in the image. Later on it is segmented using connected component method. Discrete Cosine Transform (DCT) is employed for loss-less compression of input human face-image. Segmentation is carried out for the detection of the boundaries of the objects present in the image and also used in detecting the connected components between pixels. Hence the Region of Interest (ROI) is detected and the relevant features are extracted. The physical characteristics have been calculated using Euclidean distance measures. Based on these features relevant parameters have to be extracted. The relevant feature based parameters that have been extracted are fed as input to an Artificial Neuron. Here the feed-forward network has to be used as a topology and backpropagation as a learning rule for the formation of corpus or knowledge-based model called Automatic monitoring System (AMS). Understanding involves utilization of the AHFM model for recognition of physiological and behavioral traits. The recognition process has been done by using neuro-genetic based behavioral lifting scheme of wavelet transform. The AMS model has to be optimized for the best match of features using forward-backward dynamic programming method and genetic algorithm method. The classification has been carried out using Bayesian Classification for the determination inputimage sequence.

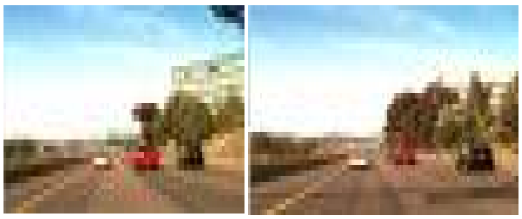

Figure 3: On Applying MMST Algorithm for Vehicle Tracking

Figure 4: On Applying Kalman Filter Method for Vehicle Tracking

Figure 5: On Applying develop algorithms for moving object detection and tracking

Table 1: Number of frame and with accuracy with different algorithms

Number of frames	MMST	KF	DA
200	64	57	67.5
150	64.5	56	68
100	64.2	55	58.7
75	60	53	68
50	58	49.5	62.5
25	54	38.6	38.5
15	46.5	25	19.2
10	40	16	8.4
5	25	0.4	8.6
0	0.3	0.3	0.1

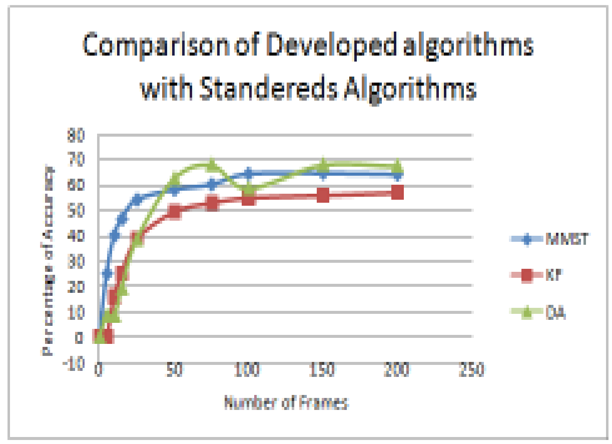

Figure 6: Comparison Developed algorithms with MMST and Kalman Filter Object tracking methods

CONCLUSION

In Conclusion, we have utilized a new, real world source of images to test a verity of algorithms for holistic performance with respect to the potential application of object detection and tracking methods. The Developed algorithms has been tested and accuracy is 70% at the cost of high computations and memory requirements.

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