A Review Survey on Smoke Detection
Shobhit Garg & Akhilesh Verma
Department Of Computer Science and Engineering, Ajay Kumar Garg Engineering College, Ghaziabad, India

Abstract:- The quickly detection of smoke in outer areas using video frame is important task of modern surveillance system. Real video include things that are same to smoke with changing behavior due to low resolution, blurred or weather properties. So we need a detection of smoke in such cases. Since smoke does not have fixed shape. Smoke is also affected from surroundings areas such as lightning affect. Smoke work as indicator for presence of fire. In image processing, images like video frames or pictures are the inputs and output can be an image or image characteristics. Various tasks like classification, features extraction, recognizing different patterns can be performed using image processing. Image processing techniques greatly help to detect smoke/fire in a good manner and thereby avoid dangerous situation according to the output. We will discuss different techniques for detection of smoke.

INTRODUCTION
The reliable smoke detection in large and open areas is defined to the task of urban safety as well as ecological Disaster in order to control fire efficiently. In the most cases a smoke is a good property of fire appearance. Computer vision algorithms are being created to generate reliable prediction of fastest smoke detection. Enhancements are being made for difference between smoke regions and regions that same to smoke. Usually smoke and fire detection are taken as separate issues because of their different dynamic properties and spatial analysis based on snapshots from video sequence. Some researchers investigate a smoke – fire - flame appearance as a unified process in outdoors areas. However, techniques are required that can stop such dangers with more accuracy and low false alarm rates. The last proposition is important due to changing behaviour of shape, color, transparency, turbulence variance, non-stable motion, boundary roughness, and time-changing flicker effect in the boundaries of smoke as well as artifacts during shooting. There are often introduced through low resolution, blurring, and bad weather conditions.

Various methods of image processing can be used to detect smoke. In image processing image is taken as input and the output can be either an image or parameters or features of an image. It is the processing of 2D image. Various tasks like classification, features extraction, recognizing different patterns can be performed using image processing. The attributes and textures of smoke can extract using image processing techniques. By these techniques the dangerous situations occur due to fire can be avoided and save the lives. This paper describes different smoke detection techniques and their comparison.

LITERATURE REVIEW
Feinui yuan proposed a fast accumulative motion orientation model based on integral image for video smoke detection. This model is able to mostly remove the disturbance of artificial lights and non-smoke moving objects by using the accumulation of motion. This model combined with chrominance detection can correctly detect the existence of smoke.[1]

Jayavardhana Gubbi proposed a novel method for smoke characterization using wavelets and support vector machines. The results are good with limited false alarms rate. This proposed technique is evaluated for its characterization properties using motion segmented images from a commercial surveillance system with good results.[2]

Yaqin Zhao proposed presents a novel smoke detection method of early forest fire video using CS Adaboost algorithm. Firstly, motion regions are extracted from two adjacent frames by a proper background model which can avoid false positives of some static factors which distract, such as blue sky and gray leaves. Then, a CS Adaboost algorithm is used to identified smoke regions using centroid movement by means of smoke flutter, image energy on the basis of wavelet transform coefficients and color information between a reference smoke color and the input frame coefficients and color information between a reference smoke color and the input frame.[3]

A good and robust smoke detection technique based on image information. Firstly we extract moving objects of images as smoke candidate area in a pre-processing. Because smoke has a
characteristic pattern as image information, we perform smoke patterns as appearance. Here we use texture analysis to extract feature vectors of images. To classify take-out dynamic objects are smoke or non-smoke, we use support vector machine (SVM) with texture features as input features.[4]

In order to progress the efficiency of the video-based smoke detection, a novel video-based smoke detection method is proposed by using a histogram series of pyramids. The method involves four steps. Firstly, through multi-scale analysis, a 3-level image pyramid is constructed. Secondly, local binary patterns (LBP), which are insensitive to image rotation and illumination conditions, are extracted at each level of the image pyramid with uniform pattern, rotation invariance arrangement and rotation invariance uniform arrangement to generate an LBP pyramid. Thirdly, local binary patterns based on variance (LBPV) with the same arrangement are also adopted in the same way to generate an LBPV pyramid. And fourthly, histograms of the LBP and LBPV pyramids are calculated, and then all the histograms are concatenated into an enhanced feature vector. A neural network classifier is tested and used for discrimination of smoke and non-smoke objects.[5]

Calderara et al. provided good state-of-the-art smoke detection in large indoor environments such as houses and outdoor areas. Their method is based on wavelet transform energy functions as well as image color properties. For classification, a Bayesian approach was applied with adaptation of a possibility function to energy ratio and color information. The authors concluded that a detection rate of smoke events achieved 100% but the false alarm rate was one event every fourteen day during the day and two events every three days during the night surveillance conditions.[6]

Wildfire smoke detection is particularly essential for early warning systems, because smoke usually rises before flames arise. ByoungChul Ko presents an automatic wildfire smoke detection method using computer vision and pattern recognition techniques. Firstly, candidate blocks are recognised using key-frame differences and nonparametric smoke color models to detect smoke-colored moving objects. Eventually, three-dimensional spatiotemporal volumes are built by combining the candidate blocks in the current key-frame with the analogous blocks in previous frames. A histogram of oriented gradient (HOG) is take-out, and a histogram of aligned optical flow (HOOF) is extracted as a temporal feature based on the fact that the direction of smoke dispersal is upward owing to thermal convection. From spatiotemporal features of training data, a optical codebook and a bag-of-features (BoF) histogram are generated using our proposed weighting scheme. For smoke confirmation, a random forest classifier is built during the training phase using the BoF histogram. The random forest with the BoF histogram can improve the detection accuracy performance when compared with related techniques and allow smoke detection to be carried out in near real time.[7]

Yongming Zhang presents a smoke-detection method for transportation hub complex early fire alarming based on video processing. Gaussian mixture model for background modeling is adopted in this paper to conduct video image preprocessing, where a number of video sequences are used to produce and maintain a background model. The suspicious region is extracted by using background subtraction and graphics primitive segmentation. Then the feature of the suspicious region is investigated. We apply discrete wavelet transform (DWT) to extract the energy eigen value for sub-image of moving target, and the ratio of movement speed in the center and regional bottom of the moving target to judge the whole its movement characteristics.[8]

In work, Histograms of Oriented Gradients (HOGs) and Histograms of oriented Optical Flow (HOFs) were constructed in order to constructed the spatiotemporal descriptor for each “smoke” block from five neighboring frames. Then the SVM classifying was done. These research were continued by Ko et al and Barmoutsis et al.[9]

For improvement in the smoke detection accuracy, Yang and Zheng proposed to use the AdaBoost algorithm for smoke detection and classifier based on back propagation in NN. The AdaBoost algorithm include multiple NNs as a set of strong classifiers. The topology architecture of each NN includes 22 input nodes, 22 hidden nodes, and one output node. This approach provided an accuracy rate of 95.66% and false positive rate of 8.62%.[10]

To handle the problems of dynamic shapes of smoke, intra-class variations, occlusions and clutter, a double mapping framework was proposed to take out partition based features with the AdaBoost algorithm[11]. The first mapping was based on a feature vector as the concatenating histograms of edge orientation, edge magnitude and the LBP, color intensity, and saturation. As a result, many multi-scale divisions are generated by changing block sizes and partition schemes in order to produce the shape-invariant features. The second mapping was built using statistical features (mean, variance, skewness, kurtosis, and Hu moments) calculated from block features. Then the AdaBoost
algorithm was used to select the discriminative shape-invariant features from a feature pool.

Vidal-Calleja and Agamenoni introduced the unsupervised classifier of unstable smoke patterns, which simultaneously created a codebook and classify the smoke using a bag-of-words paradigm, based on the Latent Dirichlet Allocation (LDA) model. In experiments, 151 ground truth segmented images with a total number of 97,370 features were prepared. The precision of smoke and non-smoke regions detection using the LDA classification method achieved 67.12% and 95.33%, respectively[12]. The brief survey demonstrates different approaches. One can see the best results, when smoke is considered as a changing behaviour texture with the special properties in the spatio-temporal domain.

SMOKE AS A DYNAMIC TEXTURE
Smoke and fire can be identified and verified by using Dynamic Textures (DTs) even in static scenes under wind rendering in natural environment. In recent years, the study of the DTs approach attention and interest in order to model and classify such complicated non-rigid gaseous objects. The main difference in DT from static texture connects with changing motion behavior, and substance such as smoke contains weakly predicted motion in the temporal domain because of simultaneous affect of many external factors.

The DT recognition methods can be conditionally classified in the generative, motion field, and discriminative methods. The general methods inherit the underlying physical dynamic system or phenomenon with visualization of DT sequences. Saisan et al. considered an image series with dynamic texture (foliage, water, ocean waves, and smoke) as a realization of a second-order stationary stochastic process under the assumption that the joint statistics between two time instants are shift-invariant. In order to availability a simple statistical description in the space of models, a class of probability densities on the Stiefel manifold was introduced.[13]

Three distances measures were used to calculate the principal angles between specific subspaces, Martin distance, and geodesic distance. Chan and Vasconcelos introduced a term “kernel dynamic texture” as a kernel based on the principal component analysis and studied the DT representation as a non-linear dynamic system.[14]

Peteri and Chetverikov show that the normal flow field contains both temporal and structural information about the DTs, and the temporal regularity features (motion patterns) can be used to classify the DTs. The classification without explicit modeling of the underlying dynamic system is in the basis of discriminative methods. [15]

Zhao and Pietikainen modeled the DTs by Volume Local Binary Patterns (VLBP) with the co-occurrences on Three Orthogonal Planes (LBP-TOP) in order to make the approach computationally simple and easy to extend. The local texture descriptors based on the Volume LBP were applied in facial image analysis due to their robustness to challenges such as pose and illumination changes.[16]

Ravichandran et al. proposed a collection of Linear Dynamics Systems (LDSs) describing the dynamics of spatio-temporal video blotches of the DTs and built the Bag of Systems (BoSs) representation similar to the Bag of Features (BoFs) representation.[17]

Kosmas Dimitropoulos introduce a new higher order linear dynamical systems (h-LDS) descriptor. The proposed h-LDS descriptor is based on the higher order decomposition of the multidimensional image data and enables the analysis of dynamic textures using information from various image elements. In addition, we propose a methodology for its application to video based early warning systems focusing on smoke identification. More specifically, the proposed methodology enables the representation of video subsequences as histograms of h-LDS descriptors produced by the smoke candidate image patches in each subsequence. Finally, to further improve the classification accuracy, we propose the combination of multidimensional dynamic texture analysis with the spatiotemporal modeling of smoke using a particle swarms optimization approach. The ability of the h-LDS to analyze dynamic texture information is evaluated through a multivariate comparison against standard LDS descriptor.[18]

CONCLUSION AND FUTURE WORK
Smoke detection algorithm based on local binary patterns. In smoke detection, LBP is not only a simple operator but also effective to lighting condition variations, which can contribute to obtain accurate results. We also combine with AdaBoost, that is important machine learning techniques, to improve the accuracy of detection results. As the preprocessing, we take-out the moving objects as candidate smoke regions in images. From the subtracted images, we computed LBP values histograms from the image blocks. Using LBP bar graph as the input vector and LBP of AdaBoost, we
detect whether the image blocks are smoke or non-smoke.

There are various problems identified in previous methods. Lower computational efficiency in surfacelet transform and HMT model. Some use for detection of flame not smoke. There exist a problem of false alarm rates. Fire detection based on binarization method is used only for avi and mpg files and there is compatibility issue with operating system above 32 bit. In background subtraction method, if fire is small and far away from camera or covered by dense smoke, so this method performs poorly. Method based on color feature has drawback i.e. correct and punctual detection of fire is not possible and comparison is required to identify smoke. One is to improve background model to effectively detect candidate smoke region in smoke-like area. Another is to extract more effective features for completely excluding the interference of heavy fog.

There are various methods have been developed for detection of smoke which is used for safety purpose. Some method is generated to reduce false alarm rates. Some method can detect only flame not smoke. Smoke and smoke-like object can be identified by joining visible and infrared images. There are different versions of LBP, i.e., STLBP (spatio-temporal local binary pattern), 3D LBP, Ternary LBP which are used for smoke detection. Classification of smoke is done in three region i.e. transparent smoke region, dense smoke region and non-transparent smoke region. Some further challenges regard higher order linear dynamical system is that it is suitable for static camera only.

REFERENCES


4. A novel smoke detection method using support vector machine 2010

5. Video based smoke detection with histogram sequence of LBP & LBPV pyramid.


