6.	Wavelet based smoke detection method with RGB contrast-image and shape constrain	J. Chen, Y.Wang, Y. Tian, and T. Huang	2013	Smoke detection in video surveillance is very important for early fire detection. A general viewpoint assumes that smoke is a low frequency signal which may smoothen the background. However, some pure-colour objects also have this characteristic, and smoke also produces high frequency signal because the rich edge information of its contour. In order to solve these problems, an improved smoke detection method with RGB Contrast-image and shape constrain is proposed. In this method, wavelet transformation is implemented based on the RGB	Detecting smoke in video surveillance is very important for early fire detection and wavelet based methods are widely used, however, they can't distinguish smoke with general pure color objects and ignore the high frequency produced by smoke. In this paper we introduce the concept of contrast image and on the basis of contrast-image, background frame's wavelet transformation and current frame's wavelet transformation are obtained respectively. Since edges correspond to high frequency and smoke corresponds to low frequency, we calculate the rate of high frequency and low

				Contrast-image to distinguish smoke from other low frequency signals, and the existence of smoke is determined by analysing the combination of the shape and the energy change of the region. Experimental results show us method outperforms the conventional methods remarkably.	frequency in order to decide whether the motion area is smoke or not.
7	Anisotropic LBP descriptors for robust smoke detection	H. Maruta, Y. Iida, and F. Kurokawa	2013	Image based smoke detection is a difficult problem especially in open areas since it is heavily affected from its environmental objects. This comes from the transparent property of smoke itself. Therefore, to realize robust smoke detection in such situation, it needs to take into account the effect of the	This paper presents a novel smoke detection method based on anisotropic LBP descriptors and AdaBoost. Anisotropic LBP descriptors are designed to have good properties to handle smoke information. That is, anisotropic LBP descriptors are considered to be effective to illumination variations and it can handle the deformation of

				degree of transparency, the change of background objects and so forth. To describe smoke information by image features, they are affected from degree of transparency of smoke, background objects, and other environmental conditions such as the direction and the speed of wind. To address such problems, a novel image feature is applied and named anisotropic LBP descriptors, which is considered as an extended variant of LBP. The anisotropic LBP descriptors are simply extended from LBP, which are defined as texture operator using anisotropic neighbourhood pixel values. Therefore, they can describe anisotropic deformed image	smoke by environmental conditions. These properties suggest that they are suitable for our purpose and possibility to provide the robust detection method. The adoption of AdaBoost method to improve the accuracy of detection results in varying conditions.

				information, which are caused from environmental conditions.	
8	An early smoke detection system based on increment of optical flow residual	Y. Zhao,W. Lu, Y. Zheng, and J.Wang	2012	In this paper, an early smoke detecting system that can efficiently extract dense smoke regions is proposed. Firstly, since the brightness in the areas that have dynamic texture is not constant, the residuals of optical flow are calculated to locate suspected smoke regions. A certain threshold of the increment of optical flow residuals is also used to distinguish smoke from other dynamic texture. Secondly, five features that can jointly represent a smoke area, including greyish colour, chrominance decrease, edge energy decrease,	this paper proposes an early smoke detection system. Firstly, the existence of smoke by the increment of optical flow residual, which can distinguish smoke from other kinds of dynamic texture effectively. Secondly, the dense suspected smoke regions are located precisely with a threshold of the optical flow residual. Finally, five features of smoke are chosen and summed up with different weights to make final decision.

				optical flow orientation diffusion and circularity, are chosen by thorough experiments.	
9	A novel video-based smoke detection method using image separation	H. Tian, W. Li, L. Wang, and P. Ogunbona	2012	In the state-of-the-art video-based smoke detection methods, the representation of smoke mainly depends on the visual information in the current image frame. In the case of light smoke, the original background can be still seen and may deteriorate the characterization of smoke. The core idea of this paper is to demonstrate the superiority of using smoke component for smoke detection. In order to obtain smoke component, a blended image model is constructed, which basically is a linear combination of	To conclude, in order to eliminate the adverse effects of background on smoke characterization, a novel image separation-based method is proposed to perform smoke detection in videos. The introduced smoke opacity and smoke component are used together to serve this purpose. The effectiveness of the proposed method is validated by experimental results. To our best knowledge, this is the first exploration on vision-based smoke detection which tries to extract features from smoke

				background and smoke components. Smoke opacity which represents a weighting of the smoke component is also defined. Based on this model, an optimization problem is posed. An algorithm is The resulting smoke opacity and smoke component are then used to perform the smoke detection task. The experimental results on both synthesized and real image data verify the effectiveness of the proposed method.	component. In general, this paper presents ideas pioneering a new direction for vision-based smoke detection and some related topics are still open. Under this framework, three issues are worth further attention. Firstly, in image separation part, only "local smooth" constraint is considered for smoke.
10	The design and implementati on of fire smoke detection system based on FPGA	L. Jinghong, Z. Xiaohui, and W. Lu,	2012	This paper uses modular method to design smoke detection system. On the basis of the requirement analysis, the paper designs and implements all the modules, including image capture module, SDRAM data	This paper designed and realized the fire smoke detection system, realized the real-time smoke extraction to video images, and realized regional stability algorithms of smoke diffusion

				buffer module, image display module and smoke detection module. Among them the smoke detection module is the core of the system, which decides the performance of the system. Using a synergistic manner through software and hardware, the smoke detection module is realized.	characteristics and smoke moving characteristics with hardware description language programming applying to suspected area with the help of Altera companies which provided Cyclone II EP2C35 development board.
11	FPGA based FNN for accidental fire alarming system in a smart room	G. P. Rashmi and L Nirmala	2014	The main objective of the paper is to design and develop the Fuzzy Neural Network for increasing the efficiency of an application which is controlled by optimizing the area and power parameters based on FPGA. Fuzzy reasoning can express the qualitative aspect of human logic. It realizes the flexible reasoning corresponding to human logical reasoning, extensive	The paper proposes an FPGA based Fuzzy neural network architecture using Takagi Hayashi method for a smart room was implemented successfully. The hardware architecture proposed allows FNN T-H on FPGA devices to be embedded and can be used for applications in the control area, prediction problems, interpolation and other problems.

				research has been conducted into fuzzy reasoning. This paper describes the design and implementation of FNN for an embedded system for enhancing the performance using cognitive knowledge where in the proposed system a smoke sensor and a fire sensor are used to maintain the safety of a smart room driven by an FNN.	The MLP networks provide a soft computation to generate the parametric equations of membership functions and consequents equations. The training method proved to be efficient, including the Self-Organizing Map for data clustering and back propagation to train all MLP networks. The proposed architecture will be used to develop a system with online training to embed control problems using FNN T-H.
12	Real-time image smoke detection using staircase searching-based dual threshold AdaBoost and dynamic analysis	F. Yuan, Z. Fang, S. Wu, Y. Yang, and Y. Fang,	2015	It is very challenging to accurately detect smoke from images because of large variances of smoke colour, textures, shapes and occlusions. To improve performance, the authors combine	When smoke emerges, the quality of videos will greatly decrease, resulting in inaccurate, unreliable features. Up to now, most of video smoke detection methods

	.			dual threshold AdaBoost with staircase searching technique to propose and implement an image smoke detection method. First, extended Haar-like features and statistical features are efficiently extracted from integral images from both intensity and saturation components of RGB images. Then, a dual threshold AdaBoost algorithm with a staircase searching technique is proposed to classify the features of smoke for smoke detection. The staircase searching technique aims at keeping consistency of training and classifying as far as possible. Finally, dynamic analysis is	suffer from high false alarm rates and low detection rates. To enhance the robustness of image smoke detection, extended Haar-like features are used and statistical features extracted from both intensity and saturation images. As the features are computed via integral images, the speed is very fast. Then, a dual threshold AdaBoost algorithm with a staircase searching technique is proposed for video smoke detection. This method avoids inconsistency of training and classifying, and greatly improves generalisation in comparison with the standard AdaBoost algorithm. To reduce false alarm rates, the dynamic analysis is proposed to

				proposed to further validate the existence of smoke. Experimental results demonstrate that the proposed system has a good robustness in terms of early smoke detection and low false alarm rate, and it can detect smoke from videos with size of 320 × 240 in real time.	further validate the existence of smoke by computing the smoke possibility of candidate regions from sequential images. Experiments show that our algorithm has a good robustness for smoke detection at interactive frame rates.
13	SuBSENSE: A universal change detection method with local adaptive sensitivity	P. L. St-Charles, G. A. Bilodeau, and R. Bergevin,	2015	Foreground/background segmentation via change detection in video sequences is often used as a stepping stone in high-level analytics and applications. Despite the wide variety of methods that have been proposed for this problem, none has been able to fully address the complex nature of dynamic scenes in real surveillance	Experiments on the largest change detection dataset available yet have shown that, in terms of average F-Measure, all previously tested methods were surpassed in nine out of eleven scenario categories as well as overall. Categories where our segmentation results were still inaccurate can be considered the next major challenge in change detection: in those cases, the

				tasks. In this paper, a universal pixel-level segmentation method is presented that relies on spatiotemporal binary features as well as colour information to detect changes. This allows camouflaged foreground objects to be detected more easily while most illumination variations are ignored. Besides, instead of using manually set, frame-wide constants to dictate model sensitivity and adaptation speed, pixel-level feedback loops were used to dynamically adjust our method's internal parameters without user intervention. These adjustments are based on the continuous monitoring of model fidelity	assumptions that have been commonly followed since the late 1990s no longer hold (e.g. the camera no more static). These experiments have also confirmed the benefit of using LBSP features in our pixel models as well as the benefit of using our continuous parameter adjustment scheme based on model fidelity and segmentation noise.

				and local segmentation noise levels. This new approach enables us to outperform all 32 previously tested state-of-the-art methods on the 2012 and 2014 versions of the ChangeDetection.net dataset in terms of overall F-Measure.	
14	Visual tracking of human visitors under variable-lighting conditions for a responsive audio art installation	A. B. Godbehere, A. Matsukawa, and K. Goldberg,	2012	For a responsive audio art installation in a skylit atrium, a single-camera statistical segmentation and tracking algorithm is introduced. The algorithm combines statistical background image estimation, per-pixel Bayesian segmentation, and an approximate solution to the multi-target tracking problem using a bank of Kalman filters and Gale-Shapley matching.	This paper presents a single-camera statistical tracking algorithm and results from our implementation at the Contemporary Jewish Museum installation. This system worked reliably during museum hours (5-8 hours a day) over the four-month duration of the exhibition under highly variable lighting conditions.

15	Connected component labelling on a 2D grid using CUDA	O. Kalentev, A. Rai, S.Kemnitz, and R. Schneider	2010	Connected component labelling is an important but computationally expensive operation required in many fields of research. The goal in the present work is to label connected components on a 2D binary map. Two different iterative algorithms for doing this task are presented. The first algorithm (Row–Col Unify) is based upon the directional propagation labelling, whereas the second algorithm uses the Label Equivalence technique. The Row–Col Unify algorithm uses a local array of references and the reduction technique intrinsically. The usage of shared memory extensively	Two type of iterative algorithms for labelling connected components on a 2D binary grid were described. The first one is a ‘‘Row–Col Unify’’ algorithm which implements the directional propagation labelling technique into CUDA. It was shown that there are two major advantages of the ‘‘Label Equivalence’’ algorithm over the ‘‘Row–Col Unify’’ one. The first advantage is the simpler implementation which leads to much less instructions. The second one is concerned with a reduced number of iterations needed for the procedure to expand the smallest label on a whole connected component. In the

				makes the code efficient. The Label Equivalence algorithm is an extended version of the one presented by Hawick et al. (2010) [3]. At the end the comparison depending on the performances of both of the algorithms is presented.	case of a spiral distribution of occupied cells for a 1024×1024 grid the number of iterations needed was 514 for the ‘‘Row–Col Unify’’ algorithm and 3 for ‘‘Label Equivalence’’. This demonstrates that the productivity of the second algorithm depends on the topology weaker than the productivity of the first one. In general, the second algorithm is 15 ~ 35 times faster compared with the first one. Another advantage of the ‘‘Label Equivalence’’ algorithm is its capability to be easily extended to calculate additional integral characteristics of each connected component, like size, perimeter or area.