Semantic Object Extraction of Videos using FCM-GA in VISCOM

Shilpi Arora, (Prof.)A. A. Junnarkar

Abstract— **Video-based applications are largely being used. these days. These applications include video surveillance, criminal detection and sports video analysis etc. In order to extract video semantic content, an Automatic semantic content extraction framework is used which make use of VISCOM to extract object, events, concepts and represents spa tial /temporal relationship between them. In this model image segmentation is being performed using Genetic algorithm based classifier. To find the optimal solution from genetic algorithm, it is required to maintain the larger population size. In some cases, however, the cost to evaluate each individual is relatively high and it is difficult to maintain large population. To overcome this problem a partially evaluated GA based fuzzy clustering technique is used which considerably reduces evaluation cost without any loss of its performance. It evaluates only one representative for each cluster. Proposed hybrid approach uses Fuzzy c-means clustering algorithm in combination with GA. FCM helps GA in selecting the population and fitness function is applied using FCM. When we apply fuzziness and number of iterations on the candidate population, we get the clustered population which is fed to Genetic Algorithm and segmentation takes place. For Empirical study sports videos are used to evaluate the implemented proposed approach.**

Index Terms— **Semantic Object Extraction, Classification, Fuzzy c-menas(FCM), Genertic Algorithm (GA), Image Segmentation, clustering, VISCOM.**

I. Introduction

Image analysis is meant to extract meaningful entities from visual data. Image segmentation is used to locate objects and boundaries in image. It is a process to assign a label to every pixel in an image i.e. pixel with the same label share some amount of visual characteristics. Because of this rapid growth of available amount of video data, there has to be an intelligent system to extract the semantic contents from video automatically. There is a framework which does perform this task which is Automatic Semantic Content Extraction Framework (ASCEF), which does make use of VISCOM (Video Semantic Content Extraction Model) for content extraction [1]. The process of extracting semantic content can also be referred to as Semantic Video object extraction. The main objective of this extraction process is spatial accuracy, which means exact definition of object boundary. Another objective of Semantic video object extraction is temporal coherence. Temporal coherence can be seen as the property of maintaining the spatial accuracy in time. This allows us to adapt extraction to the temporal evolution of the projection of the object in successive image. There are many studies in the literature about object identification in video. We can classify these in three levels as Manual extraction, Fully automatic and semiautomatic. Performing classification or applying rules to the extracted low level features from image using Algorithm can be considered as Automatic object extraction technique. For this purpose, in the existing system they have used Genetic Algorithm. To get the optimal solution from this approach it is desirable to maintain the population size as large as possble. But in some cases, the cost to evaluate each individual is relatively high and it is difficult to maintain large population. Secondly the chromosome of GA is randomly chosen in the image of the pixel.For this we need to have a prior knowledge of population size P, also there is aneed to predict the optimal number of clusters, required to partition dataset, in advance. To solve these problems, a hybrid approach of Fuzzy c-means and Genetic Algorithm is used.Fuzzy c-means clustering helps in generating the population of genetic algorithm which there by automatically segments the images [2]. This considerable reduces the evaluation cost without any loss of its performance by evaluating only one representative of each cluster. Due to explosive growth of sports video content and the increasing need for the access of sports video content, empirical study of this paper is performed using sports video datasets. The Paper is organized as follows. In Section II, the Literature survey is presented. Section III, explains the System Design, Section IV, Results set. Section V, Conclusion.

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II. Literature Survey

Object extraction process consist two aspects; feature extraction from image and use these extracted features to achieve the segmented image. Various studies have been performed on improving the image segmentation using Genetic Algorithm based on Fuzzy clustering. But none of the approach has incorporated this technique in any of the extraction framework. [1] Deals with Automatic content extraction using VISCOM model and exceptions are handled through Rule Base approach. Semantic content extraction process is done automatically. In addition, a generic ontology-based semantic metaontology model for videos

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(VISCOM) is proposed. VISCOM is a well-defined metaontology for building the Domain Ontologys. Objects, events, concepts, spatial and temporal relations are the components of this generic ontology based model. There are two major steps followed in this automatic semantic content extraction technique. The initial step is to extract and classify object instances from consecutive frames of shots of the video instances. The second step is to extract events and concepts by using domain ontology and rule based definitions. The first semantically significant components are spatial relation instances among object instances. After that, the temporal relations are extracted through changes in spatial relations. At last, events and concepts are extracted by using the spatial and temporal relations Moreover, the semantic content representation capability and extraction success are improved by adding fuzziness in class, relation, and rule definitions. An automatic Genetic Algorithm based object extraction method is integrated to the proposed system to capture semantic content. [2]This paper describes an evolutionary approach for unsupervised gray-scale image segmentation that segments an image into its constituent parts automatically. In this paper, fuzzy c-means clustering helps in generating the population of Genetic algorithm which there by automatically segments the image. Considering the multiple categorization, the problem is classifying an object S to some category. To decide on this classification, the principals of natural genetic are applied on the problem accordingly. Gene of the chromosome determines the decision of their related chromosome and all chromosomes determine the final decision of the class. In other words, chromosomes cooperate to make a decision for the class, although they compete for appearing in the next generations and becoming more dominant on the decision giving process. In this paper, that the user does not need to predict the optimal number of clusters, required to partition the dataset, in advance. Comparison of the experimental results with that of other clustering methods, show that the technique gives satisfactory results when applied on well known natural images.[3] An automatic cluster-based object extraction method is integrated to the proposed system to capture semantic content and explanation in textual format.An automatic cluster-based object extraction method is integrated to the proposed system to capture semantic content and explanation in textual format. The framework can improve the personalized querying a retrieval capabilities of user. It provides explanation for physically challenged users and consumes less time.[4] FCM is a popular clustering method and has been widely applied for medical image segmentation. Although many variations of FCM algorithm have been performed by many researchers but none of them are flawless. A method based on genetic algorithm with use of FCM is proposed in this paper. In this algorithm, local neighbor pixels are used. They tested algorithm on simulated MR images and obtained the right number of the segments fully automatically. Here they have reduced the number of iterations of genetic algorithm and increased the convergence speed by applying proposed technique.[5] in this paper sports video analysis have been performed on semantic extraction and editorial content creation and adaptation. Feature extraction framework have been used which uses low-level to mid-level features of videos are extracted and these analysis techniques are applied on various applications, including event detection, tactic analysis, player action recognition etc. [6] this paper deals with various object extraction techniques; Manual, Automatic and semi-automatic. The applicability of these methods and their limitations are discussed. Also Automatic tools for evaluating their performance are introduced. [7] This thesis implements the Genetic algorithm for object classification. Thesis has detail explanation on keyframe extraction from videos, feature extraction using MPED-7 descriptors and Object extraction or decision making on extracted features using Genetic Algorithm. [8] This paper uses hybrid approach for image clustering using Genetic algorithm and Fuzzy c-means. The proposed approach is used to overcome the limitation of Fuzzy c-means which is sensitive to both noise and intensity heterogeneity since it does not take into account spatial contextual information.Genetic algorithm optimizes the performance of pure Fuzzy c-means. [9] Deals with hybrid approach of Genetic Algorithm and Particle Swarm Optimization to optimize pure Fuzzy c-means algorithms. Fuzzy c-means is sensitive to noise, the hybrid approach is used to overcome this limitation. Medical images are used for empirical study. [10] This paper gives the comparative study on Manual and Automatic process of Object extraction. Also explains the overview of VISCOM and advantages of using Automatic techniques for Semantic content extraction of Videos.

III. EXISTING SYSTEM

An Automatic semantic content extraction frame work (ASCEF) is used for bridging the gap between low-level representative features and high level semantic content in terms of object, event, concept, spatial and temporal relation extraction. This frame work make use of VISCOM model that uses objects and spatial/temporal relations in event and concept definitions are created. The extraction process starts with object extraction. Specifically, a semiautomatic Genetic Algorithm-based object extraction approach is used for the object extraction and classification For each representative frame, objects and spatial relations between objects are extracted. Then, objects extracted from consecutive representative frames are processed to extract temporal relations, which is an important step in the semantic content extraction process.

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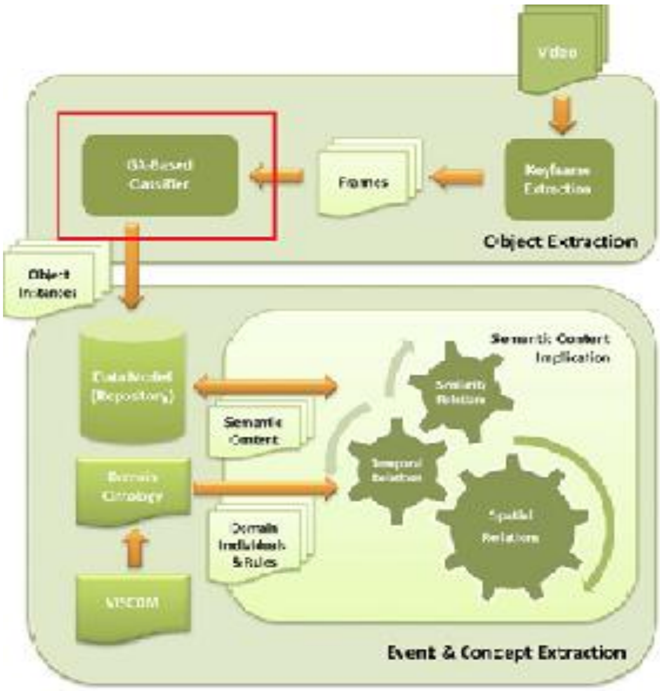

Figure 3.1 Automatic Semantic content Extraction Framwork

In these steps, spatial and temporal relations among objects and events are extracted automatically allowing and using the uncertainty in relation definitions. Event extraction process uses objects, spatial relations between objects and temporal relations between events. Similarly, objects and events are used in concept extraction process. semantic content extraction process is developed considering uncertainty issues. For the semantic content representation, VISCOM ontology introduces fuzzy classes and properties. Spatial Relation Component, Event Definition, Similarity, Object Composed Of Relation and Concept Component classes are fuzzy classes as they aim to having fuzzy definitions In the below system architechture(Figure 3.1), the highlighted function (GA-Based classier) is updated in order to get the segmented images for VISCOM. Object extraction is done using Genetic algorithm and classification is performed. Whereas the proposed implemented approach make use of Fuzzy c-meams based genetc algorithm for object extraction and classification.

IV. PROPOSED SYSTEM FRAMEWORK AND DESIGN

A. System Design For Classifier

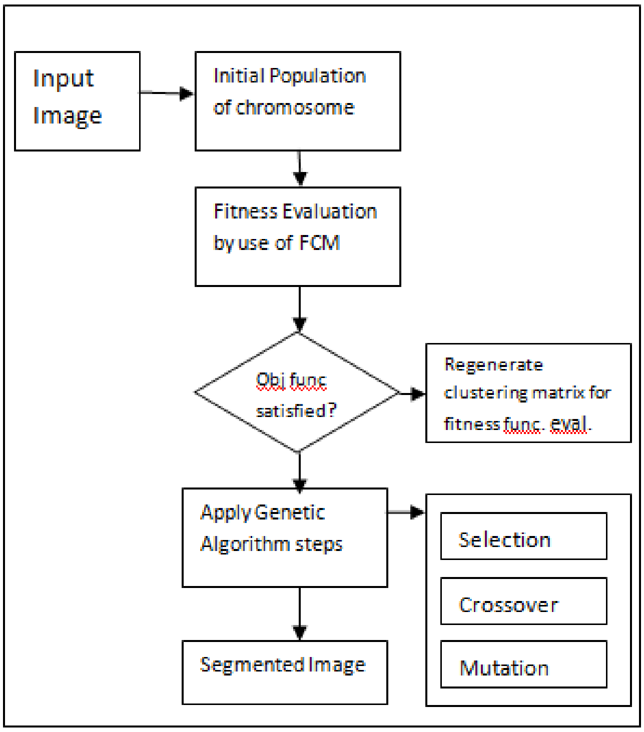

Figure 4.1 Architectural Diagram of classifier

When we input a video to the system, frames are extracted from it. These frames are the still images from the video. Now these extracted frames are fec to classifier to get the classified image which will then be fed to VISCOM to extract the concept behind the video. This extraction takes places by extracting the objects, events, spatial relationship between objects and temporal relationship between the events. Finally the concept is derived from video using these features.

For classification, we have used Fuzzy c-means based genetic algorithm. It has two benefits: We do not have to have a prior knowledge of population as FCM is the iterative process. Untill the objective function value is not satisfied, fitness is computed by recalculating the clustering matrix M.Secondly computation cost to evaluate each pixel in cluster is too high instead Fuzzy c-means uses only one representative of cluster for evaluation. In that way it overcomes the limitation of Genetic Algrithm which considerably reduces *evaluation cost* without any loss of its performance by evaluating only one representative for each cluster. Fuzzy c-means also helps in maintaining the large population size as it is desirable to have population size large to get the exact concept behind the video.

The Computational steps are described in the next section for Fuzzy c-means based Genetic Algorithm (hybrid approach).

B. Computational Steps

1. Initial Population:

Each chromosome represents a solution which is a sequence of K cluster centers. Each chromosome contain N-no of genes. For image datasets each gene is an integer representing an intensity value. In Genetic Algo- ithm, the

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population size of P is needed. In this proposed method, the FCM is run P times for generating these P chromosomes; each chromosome is of size K. The Fuzzy C-Means (FCM) algorithm is an iterative optimization that minimizes the cost function.Let X= x1,x2,., xn denotes an image with N pixels to be partitioned into c clusters, where xi represents multispectral (features) data. The cost function is defined as follows:

$$J = \sum_{j=1}^{N} \sum_{i=1}^{c} u_{ij}^{m} \| x_j - z_i \|^2 \quad (1)$$

Where uij represents the membership of pixel xj in the ith cluster, zi is the ith cluster center, $\| \|$ is a norm metric, and m is a constant[2]. The membership functions and cluster centers are updated by the following:

$$u_{ij} = \frac{1}{\sum_{k=1}^{c} \left(\frac{\|x_j - z_i\|}{\|x_j - z_k\|} \right)^{\frac{2}{m-1}}} \quad (2)$$

And

$$z_i = \frac{\sum_{i=1}^{N} u_{ij}^{m} x_j}{\sum_{j=1}^{N} u_{ij}^{m}} \quad (3)$$

2. Fitness Computation:

In fitness computation the pixel dataset is clustered according to the centers encoded in the chromosome under consideration. In the next step values of the cluster centers encoded in the chromosome are adjusted, replacing them by the mean points of the respective clusters.

Later on, the clustering metric M is computed as the sum of Euclidean distances of each point from their individual cluster centers.

$$M = \sum_{i=1}^{k} M_i, \quad i = 1,2,..K \quad (4)$$

and

$$M = \sum_{x_j \in C_i} \| x_j - z_i \| \quad (5)$$

The Fitness function is defined as:

$$f = \frac{1}{M} \quad (6)$$

3. Selection:

We use the roulette wheel technique to produce the mating pool of chromosomes. The main idea of the roulette wheel technique is to associate more chance to better chromosomes.More fit the individuals are more likely to be selected. The chance of an individual being selected is proportional to the ratio of its fitness over total fitness of the population.

4. Selection:

Crossover is the next step after the selection of parent chromosomes. In this step, a new offspring is generated as a result of combining two parents. Crossover is the process that enables gene interchange between parents so that two new individuals rae produced that are different from parent. We have used single point crossover in the proposed system.

5. Mutation:

Each iteration of the chromosome changes according to the probability. Mutation is used to perform a search over the entire range of answers. Mutation involves altering the content of the chromosomes at a randomly selected position in the chromosome, after determining if the chromosome satisfies the mutation probability.

C. Performance Parameter

1. Parameters for Genetic Operations:

Representation	Bit Representation
Crossover Type	One point crossover
Crossover Rate	0.7
Mutation Type	Bit Mutation
Mutation Rate	0.1

Table 1.1© Performance Evaluation Parameters - GA

2. Performance Evaluation Parameters used for Proposed algorithm:

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Chromosome Length	Larger the length the results would be more accurate
Validity Index	This should be minimum as its the ratio of the intra and inter cluster center distance
Sensitivity	Measures the proportion of actual positives which are correctly identified.
Specificity	Measures the proportion of actual negatives which are correctly identified
Jaccard similarity	Its and spatial overlap measure, the ratio of the true positive(TP) with TP, FP and FN
CPU Time	Time taken to segment the image
Number of Final Center	Final no of cluster center

Table 2.1© Performance Evaluation Parameters: FCM-GA

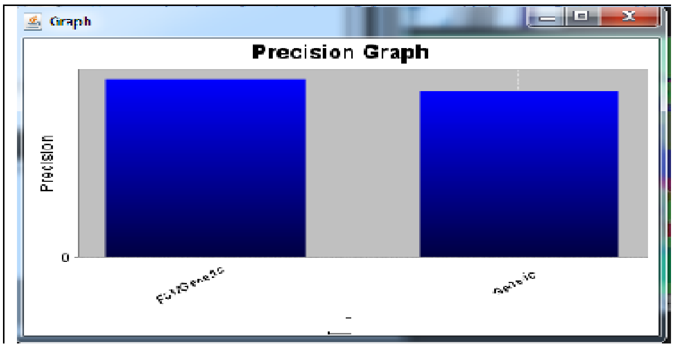
V. Result Set

In the proposed implemented system Semantic content extraction takes place in two stpes; Apply Fuzzy c-means on the candidate population and than apply Genetic Algorithm for image segmentation.In order to perform Fuccy c-means, we need to choose the number of cluster and the fuzziness level and the clusters are fed to Genetic Algorithm for segmentation to take place.

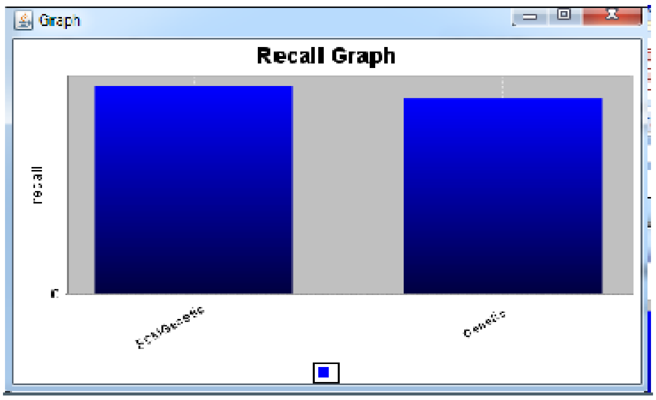
Below comparative study shows the segmented images correctness using both the approaches such as segmentation using only Genetic algorithm and segmentation using the hybrid approach. The result shows that the hybrid approach gives more accurate results than the existing approach.

The parameters used to evaluate the process are-

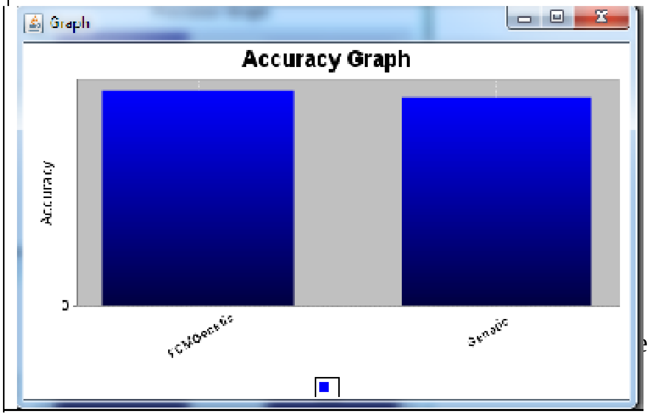
A. Precision Measure



B. Recall Measure:



C. Accuracy Measure:

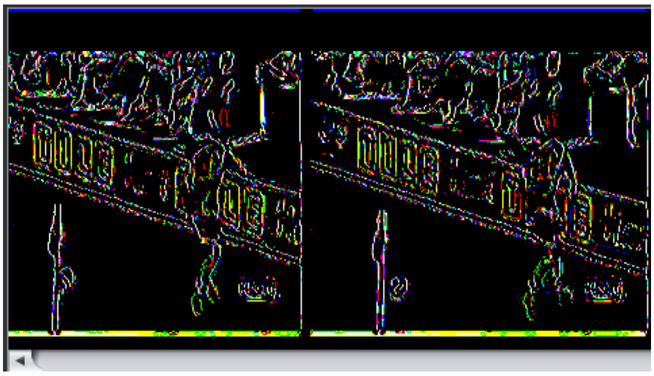


affiliations and addresses for private communications [7].

D. Computational Steps:

1. Extract Frames from Video:

2. Edge Detection:



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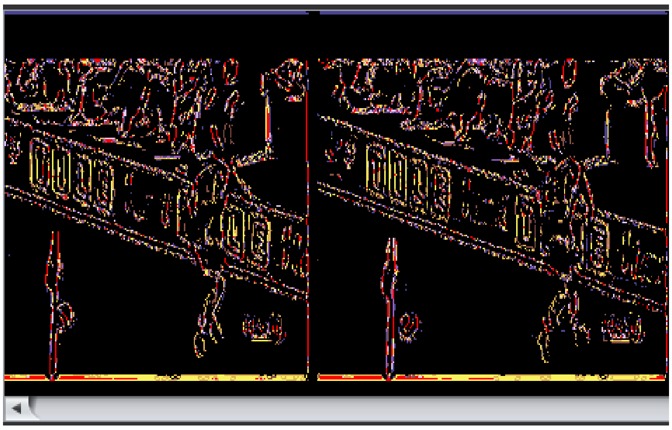
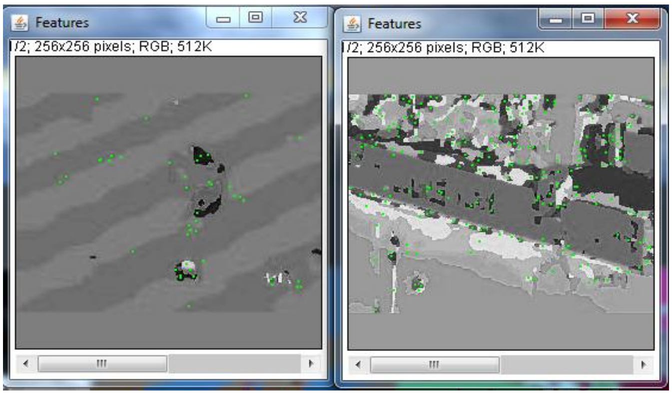
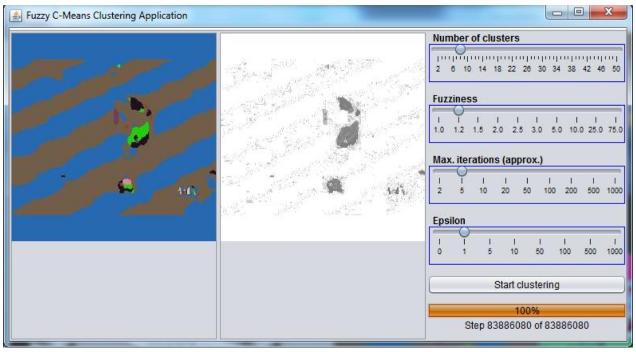
3. Initial Classifier:



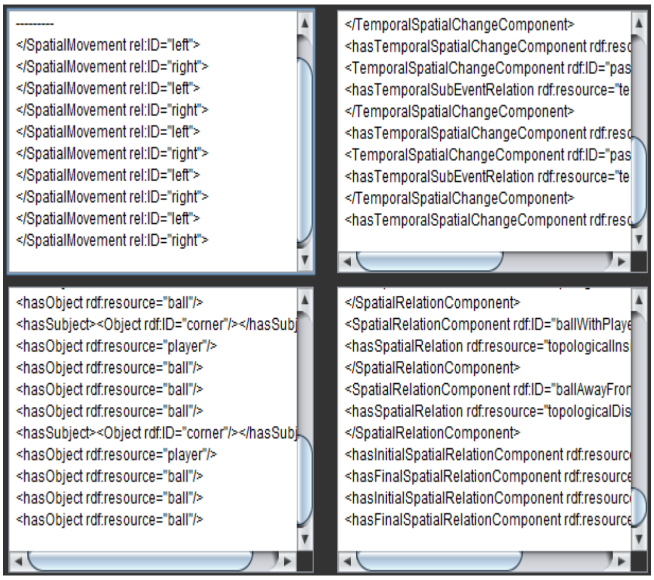
4. Feature Extraction:



5. FCM-GA segmentation:



6. VISCOM Extraction of Objects, Events, Spatial, Temporal Relations:



VI. Conclusion

Automatic semantic content extraction Framework is used to extract the semantic content from videos. It is used in many applications such as video surveillance, sport events, and news video applications. By using domain independent fuzzy ontology this can be achieved in very efficient manner.VISCOM model is based on the Object extraction and further Events are created and concepts are generated related to video and stored in the database for effective information retrieval of video contents. VISCOM uses Genetic Algorithm for Object extraction which increases the cost to evaluate the fitness of each chromosome center and there has to be prior knowledge on number of cluster being used. These limitations are eliminated using FCM based Genetic algorithm where the user does not need to predict the optimal number of clusters, required to partition the dataset, in advance. The FCM is run P times for generating these P chromosomes. Also FCM-GA considered maintaining the population size as large as possible. The hybrid approach used enhances the efficiency of GA and eliminates the limitations of FCM. Various performance measures will be used to evaluate the performance of this hybrid approach and a comparative study will be done. FCM based GA represents the Validity index lowest than k-means.The fitness value is estimated by representative of the cluster and remaining individual in each cluster get their fitness estimated by their membership value. For Empirical study sports videos are used.

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VII. Acknowledgment

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