International Journal of Pure and Applied Mathematics
Volume 114 No. 12 2017, 237-245
ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)
url: http://www.ijpam.eu
Special Issue

Ontology based Augmented Semantic Content Extraction in Videos

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Abstract

The primary focus so far in multimedia platform contributes to image and video databases which are used in various applications. The most important factor is to bridge the gap between low level features and high level semantic content by overcoming the limitation like time and querying. The suggested system includes high level features which have semantic content and it helps user to retrieve the objects and events. The most important component in high level system adheres to spatial /temporal relations which are based on ontology definition. Subsequently, an Event extraction process defines the objects, spatial relations between objects and temporal relations between events. To define some difficult situations, a separate rule to lower computation cost of spatial relation is used.

Key Words: Semantic, Ontology, Fuzzy System, Video Content Extraction.

1. Introduction

Video data can be extracted by applying different methods which are widely used. Some of the common extraction in application includes surveillance, video-on demand, intrusion detection etc. Video data extraction can be classified in to three levels such as raw video data, low level features and semantic content. Video content collected from raw and metadata serves as the essential building block elements of the infrastructure. Instead of routine metadata extraction techniques namely text mining, video processing and speech recognition Video metadata is generated manually using an explanation tool .Due to this there is tremendous increase in multimedia data. This gave rise to the necessity of semantic retrieval techniques in multimedia. This paves way for querying the multimedia data semantically.

Video content extraction can be classified as 3 categories such as unprocessed data, primary features and semantic content. The unprocessed data consists of primary physical video units in addition to the general video attributes like format, length, and frame rate. The primary features are characterized by audio, text, texture, color distribution, shape, motion, etc. Objects and events are the two main factors in semantic content extraction. First two levels deals with accessing low level features and which is not much used in actual video extraction users are mostly interested in extracting the content from videos. This is basically the extraction of semantic content of the video. Different studies imply different methodologies like object detection, tracking which apply different spatio-temporal relations

Manual extraction is time consuming, tedious and has its own limitation while querying the data. The results of such extraction do not provide satisfying results. The proposed system provides extraction framework for automatic semantic content extraction based on ontology.

The system is represented by simply relating the elementary features like size, color etc., from the extracted video without using spatial or temporal relation. By applying spatiotemporal relations the events were captured. It was identified that both spatial and temporal relation between objects and events has not been used so far in automatic semantic content extraction.

2. Video Semantic Content Model Overview (VISCOM)

VISCOM is identified as an alternative to rule based model. Developing rules is a tedious task, because various domains need different rules with different syntax. Whereas VISCOM follows well defined Metaontology for constructing domain ontologies. Though VISCOM covers all domains there are some areas which is not handled by VISCOM. In such situation additional rule based modeling with ontology is used. On the whole any generic model will follow any of the ontology domain which uses both spatial and temporal relations.

Ontology Based Modeling

Each semantic model represents objects, events and relations among the objects. VISCOM contains module and associations among this module. Two main factors such as item and occasion describes the semantic types whereas others are referred in automatic semantic content extraction process.

VISCOM is represented as follows
{
Temp_relationid ={beforeevent;meetsobject,duringevent;overlap relation; starts event ; finishes event}
Obj_composed ={Composed of ;isa;substance of ;member of;part of}
Movement ={downrelation;upobject;rightobject;leftobject;stationary}
Spatial_relation={
farobject;nearobject;disjointrelation;insideobject;parInsideobject,touchrelation;aboveobject;belowobject;leftobject;right object}
}

S.NO	Objects/Event/Relation	Parameters
1	Component	Component=>{type=>$obj_i evt_i co_i$}
2	Events	{name=>[string],eventDefinition=>[edf_i], objectrole=>[$objr_j$],tempeventcomponent=>[TEC_l] }
3	Concept	{[name]=>string, Conceptcomponent=>[cc_i]}
4	Spatial Relation	{ Type=>T_J ,P_J,D_K Where Topological Spatial Relation $T_J$is {inside, touch, partially inside} Positional spatial relation $P_J$is {rightside,leftside,above,below} Distance spatial relation $D_K$is {far,near} }
5	Spatial Relation component	{ name=[string] , object1 =>obj_i , object1 =>obj_j , spatiarelation =>SR_K }
6	Spatial change	{ name= [string], Initial_spatial_change ={SRC_I}, Final_spatial_change={SRC_J }, Object Role=>{$ObjRel_K$ }, Spatial Movement=>{SM_M}, }
7	Spatial change period	{ startToend, startTostart, endTostart,

		endToend. }

8	Spatial Movement	{
		Object movesLeft,
		Object movesUp,
		Object movesRight,
		Object movesDown,
		stationary relation
		}

9	Spatial movement Component	{
		name=> [string],
		object=>[obj_j],
		spatialmovement=>[SM_J]
		}

10	Temporal relation	{
		before object,
		During object move,
		Overlap relation,
		Starts relation,
		equal and finishes relation
		meet object
		}

11	Spatial movement Component	{
		name=> [string],
		object=>[obj_j],
		spatialmovement=>[SM_J]
		}

12	Temporal relation	{
		before object, duringrelation, overlap object, starts relation,
		Equalobject ,finishes relation, meet object
		}

13	Temporal event component	{. name=>[string], initialE=>{E_I}, final=>{E_J}, temprelation=>{TR_K} }

14	Temporal spatial change component	{
		name=> [string],
		temprelation=>[TR_k],
		InitialSC=>[SC_I],
		InitialSCR=>[SC_J]
		}

15	Event definition	{
		name=>[string],
		Spatailrelationcomponenet={SRC_I},
		Temporalspatialchange={$TSCC_J$},
		Uniquespatialchange={USC_M}
		}

3. Rule based Modeling

- Every criteria has two sections:Header and structure
- Structure part comprises of n number of classes and its respective property individuals
- Header section contains an individual μ

Both body and head parts have set of rules to be followed. There are two main reasons for the usage of rule definition. The main aim is to reduce the spatial relation cost. This provides a way to strengthen the framework for semantic content extraction process.

4. Domain Ontology Construction with VISCOM

Domain ontology was residential to confine the examined domain semantics and offer the conceptualization. In addition, analysis ontology was planned to model the semantics extraction method and the necessary qualitative and quantitative low-level in sequence definitions. It facilitates the concept based browsing and question formulation. Each occurrence has a different event to interpret. If it has an occurrence then classify event in conditions of experience definition. Verification needs to be done on each event and its temporal relation event. Then ultimately building relation identifies the real model.

```
Step 1
declare:
Objects,
Events,
Concept individuals
spatial relations happening within an Event.
Object models happening within an Event.
Step 2
define Relations
Define Semantic Contents by Spatial Relations and Motions
Find temporal relations between spatial components.
DefineSpatial Components and Temporal Spatial ConceptClasses.
Step 3:
for(all Events)
{
if(event definition)
Manipulate E in terms of Event descriptions
if(temporal relationsbetweenevents)
define Events in terms of Event Temporal Relations.
}
for(all Components)
Create relation with set of classes.
```

end for
Step 4:
state Semantics

5. Framework for Automatic Semantic Content Extraction

Extracting the semantic video content is the main motive of this framework. It takes following as the input
V_i– instance of a video
ONT_i-domain ontology for Domain i
R_i- set of rules for domain i
ASCEF = {INPUT=>{V_i,DO_i,R_i}, OUTPUT=>{VSC_i} }

Semantic contents usually represent object, event and concepts, which is a part of the selected video instances.

6. Object Extraction

Object extraction techniques are used to extract the components of objects since it is used as input in the framework. Object details are not included in this process. Object extraction refers to the definition and characteristic like shape, color and texture features. Detailing of object extraction is not present in this process. In the course of object extraction process, for each keyframe in video, object extraction is done.
Object Instance={
Frameno=>[number]
minBoundingRectangle=>{MBR_i}
membership=>{MSV_j}
objecttype={O_k}
}

7. Extraction of Temporal Relation

In the framework, temporal relations are utilized in order to add temporality to sequence spatial change or events individuals in the definition of Event individuals

8. Event and Concept Extraction

Name Notation Definition	**Before B(i,j) i+<j+**	**After A(i,j) B(j,i)**
Meets M(i,j) i+= j-	Starts S(i,j) i-= j-<i+= j+	Finishes F(i,j)i-= j->i+= j+
Name Notation Definition	Before B(i,j)i+<j+	After A(i,j) ,B(i,j)
Meets M(i,j) i+= j-	Starts S(i,j) i-= j-<i+= j+	Finishes F(i,j) i-= j->i+= j+
Name Notation Definition	Before B(i,j) i+<j+	After A(i,j) B(j,i)
Meets M(i,j) j+= j-	Starts S(i,j) i-= j-<i+= j+	Finishes F(i,j)i-= j->i+= j+

When a concept is extracted the related events are also extracted. After a series of extraction process also involves events extraction.Conceptextraction involves object and event extraction is the continuous process. These are interrelated with relations, concepts, events. Whenever a object, relation or event is extracted the related concept is also extracted semantically. Instance is automatically extracted with the relevance degree given in its definition.

9. Conclusion

An Ontology framework for extracting the contents from a video using semantics has been developed and this content extraction can be used in various applications. This extraction process uses automation of semantic content extraction is done as part of the extraction process. In addition, a generic ontology-based semantic metaontology model for videos is proposed

For future study one the model can be improved with better extraction capabilities and can also consider the viewing angle of camera and the motions in the depth dimension.

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