Identification of MPEG-4 FDP Patterns in Human Faces using Data-Mining Techniques

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ABSTRACT

In this paper we try to induce rules that describe patterns in human faces. We apply two different data-mining algorithms, C4.5 and C5.0, in a database of faces parameters in the MPEG4 FDP (Face Definition Parameters) form. Also we modify the database in two different ways before applying the algorithms: variable discretization of some fields; and selection of the main clusters with Self-Organizing Maps.

Keywords

Data-Mining, Self-Organizing Maps, C4.5, C5.0, MPEG-4 Face Definition Parameters, FDP

1. INTRODUCTION

MPEG-4 [ISO98a] is an ISO/IEC standard developed by MPEG (Moving Picture Experts Group), which defines ways to represent and compress audio, video and 2D/3D graphics objects. Particularly MPEG-4 defines 84 feature points called *Face Definition Parameters* (*FDPs)* to parameterise a face. FDPs are used to personalize a generic face model to a particular face.

In our work we have a database of faces that are described by distances between different *MPEG-4 (FDP)*. The main purpose of this work is to induce rules that describe patterns in the human faces, that means relations between different dimensions of the faces from the database (i.e. mouth width, eyebrown width, etc.)

Data mining is all about extracting patterns from a warehoused data. C4.5 is an automatic learning algorithm developed by Quinlan [Qui92a] that has been used for classifying examples. The classifiers are expressed as decision trees or sets of if-then rules forms that are generally easier to understand than neural networks. C5.0 is an improvement of C4.5 algorithm [Rul03a].

In this work we compare the results of applying C4.5 and C5.0 to the database of MPEG-4 FDPs. Rules have the "if-then" form and refer relations between different dimensions of the face, i.e. "if eye distance is bigger than… then mouth is…width".

Self Organizing Maps (SOM) [Koh01a] is the most popular artificial neural network algorithm in the unsupervised learning category. In this work we use SOM for clustering the records in the database of faces before applying C4.5 and C5.0 algorithms.

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2.EXPERIMENTATION

We have a database of faces where each record has the 19 fields shown in first column of Table 1. Except the first four fields -sex, human race, height and weight- the rest of the fields are segments of the face from one MPEG-4 FDP to another.

We apply the C4.5 and C5.0 algorithms to: the entire database (case a) and the main cluster obtained with Self Organizing Maps (case b).

Field	Commentaries
Sex	male/female
Human race	asiatic, european, etc.
Height	person's height in meters
Weight	person's weight in kg.
Face height (FH)	FPD 11.1 to FPD 2.1
Face width (FW)	FPD 10.10 to FPD 10.9
Right eye width (REW)	FPD 3.12 to FPD 3.11
Right eye height (REH)	FPD 3.14 to FPD 3.10
Right iris diameter (RID)	FPD 3.2 to FPD 3.4
Left eye width (LEW)	FPD 3.8 to FPD 3.7
Left eye height (LEH)	FPD 3.13 to FPD 3.9
Left iris diameter (LID)	FPD 3.1 to FPD 3.3
Right eyebrown (RE)	FPD 4.2 to FPD 4.6
Left eyebrown (LE)	FPD 4.1 to FPD 4.5
Nose height (NH)	FPD 9.6 to FPD 9.2
Nose angle (NA)	Angle between NH and FPD 9.2 to FPD 9.1
Nose Tip (NT)	FPD 9.3 to FPD 9.15
Mouth height (MH)	FPD 8.1 to FPD 8.2
Mouth width (MW)	FPD 8.4 to FPD 8.3

Table 1.Face record

These are the rules obtained from the entire database (case a) with the objective field "Sex":

Rules obtained with C4.5

IF weight < 63 kg. THEN sex = female

IF NA >= 81,57º THEN sex = female

IF weight >= 72 kg. THEN sex = male

IF weight < 72 kg. THEN sex = female

IF RID >= 23 mm THEN sex = male

Rules obtained with C5.0

IF weight < 70 kg. AND LE <=79mm THEN sex = female

IF weight <= 62 kg. THEN sex = female

IF weight >= 62 kg. AND LE >79mm THEN sex = male

IF weight > 70 kg. THEN sex = male

After applying Self Organizing Maps for clustering the database records according its similarities we obtain four groups of records distributed as follows: 2% in cluster 1, 10% in cluster 2, 32% in cluster 3 and 56% in cluster 4. These are the rules obtained from the main cluster (case b) with the objective field "Sex":

Rules obtained with C4.5

IF weight < 73 kg. THEN sex = female

IF height >=1.73m. THEN sex = male

Rules obtained with C5.0

Objective Field:sex

IF height <=1.69m. THEN sex = female

IF REH >54mm. THEN sex = female

IF height >1.69m. AND REH <=54mm THEN sex = male

We also change the objective field to "FH" and "FW". Since these are continuos fields a variable discretization proccess allows to use them as objetive field in the rules.

Table 2 shows for every test the number of records that can not be analysed. As this percentage dismiss the rules are more precise.

	Entire database		Main Cluster	
	C4.5	C5.0	C4.5	C5.0
No discretization	39%	0%	18%	2,9%
Discretization	58%	17.7%	43%	16.7 %

Table 2. Percentage of non-analyzed records

C5.0 vs. C4.5

- The number of records that can not be analyzed dismisses considerably by applying C5.0 instead of C4.5.
- The rules deduced with C5.0 are more complex (left part of the rule has a conjunction).

Cluster vs. entire database

- The number of records that can not be analyzed dismisses by analysing the main cluster instead of the whole database in almost all the cases.

3. CONCLUSIONS

In this paper we determine rules to identify patterns in human faces. We analyze a database of faces described by dimensions from MPEG-4 Face Definition Parameters. We compare C4.5 data-mining algorithm with a lightly different algorithm called C5.0 to conclude that the latter one is more precise to induce rules. Also we conclude that the rules a better if we use only the records of the main cluster selected by Self-Organizing Maps instead of using the entire database. The discretization of some fields allows using it as an objective of the rules.

4. REFERENCES

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