

its standard deviation and a common factor that is common to a plurality of leave nodes. It has been found that this reduces detection errors without requiring large numbers of additional training video sequences. The standard deviation may be used as a measure of statistical spread for example.

In an embodiment the processing system is configured to select the common factor in a feedback loop using the pattern detection results obtained from training examples, using respective different values of the common factor. It has been found that minimal errors are obtained for different types of actions by using different values of the common factor. By using feedback adjustment the value of the common factor can be adapted to different detection classes, so that detection errors can be reduced. For each different detection class the relative scale values may be set using the same measure of spread. This reduces the effort needed to train detectors for different classes.

In view of the above, according to a first aspect of the present application, there is provided an image pattern recognition system for detecting a pattern from at least one image based on detected interest points in the at least one image, the pattern recognition system comprising

- a feature vector extractor configured to extract feature vectors, each feature vector comprising data derived from video content in a region in a predetermined relation to a location of a respective detected interest point in the at least one image;
- a bin value computing module, configured to compute a set of bin values for bins associated with leaf nodes of decision trees of a forest of decision trees, the bin value being computed for each bin by summing contributions corresponding to the feature vectors, each contribution being computed dependent on selections of feature vector components and thresholds associated with non-leaf nodes along a path through the decision tree to the leaf node associated with the bin;

- a classifier, configured to compute a pattern detection result by comparing the set of bin values to reference sets of values,

wherein at least a first non-leaf node from the non-leaf nodes of the decision trees has an associated first scale value and at least a second non-leaf node

from the non-leaf nodes of the decision trees has an associated second scale value, the bin value computing module being configured to use a soft

decision function in the computation of the contributions for the bins

associated with leaf nodes at ends of paths through the decision tree that

include the first non leaf node, the contributions being computed in

proportion to a result of applying the soft decision function to a ratio of the first scale value and a difference between the threshold and a feature value

taken from the feature vector according to the selection of the feature vector component associated with the first non-leaf node, the second scale value

being used in the computation of the contributions for the bins associated

with leaf nodes at ends of paths through the decision tree that include the second non leaf node, the system comprising

- a processing system configured to compute the first and second scale value by determining a first and second measure of statistical spread of the

feature values taken from the feature vectors of a training set according to

the selection of the feature vector component associated with the first and second non-leaf node respectively, and setting the first and second scale

value to a product of a common factor and the first and second measure of statistical spread respectively.

According to a second aspect of the present application, there is

provided an image pattern recognition method for detecting a pattern in at least one image from detected interest points in the at least one image, the

method comprising

- extracting feature vectors, each feature vector comprising data derived

from video content in a region in a predetermined relation to a location of a

respective detected interest point in the at least one image;

- computing a set of bin values for bins associated with leaf nodes of decision trees of a forest of decision trees, the bin value being computed for each bin by summing contributions corresponding to the feature vectors, each contribution being computed dependent on selections of feature vector component and thresholds associated with non-leaf nodes along a path through the decision tree to the leaf node associated with the bin;
 - wherein at least a first non-leaf node from the non-leaf nodes of the decision trees has an associated first scale value, and at least a second non-leaf node from the non-leaf nodes of the decision trees has an associated second scale, a soft decision function being used in the computation of the contributions for the bins associated with leaf nodes at ends of paths through the decision tree that include the first non leaf node, the contributions being computed in proportion to a result of applying the soft decision function to a ratio of the first scale value and a difference between the threshold and a feature value taken from the feature vector according to the selection of the feature vector component associated with the first non-leaf node, the second scale value being used in the computation of the contributions for the bins associated with leaf nodes at ends of paths through the decision tree that include the second non leaf node.;
 - computing a pattern detection result by comparing the set of bin values to reference sets of values, the method comprising computing the first and second scale value by
 - determining a first and second measure of statistical spread of the feature values taken from the feature vectors of a training set according to the selection of the feature vector component associated with the first and second non-leaf node respectively, and
 - setting the first and second scale value to a product of a common factor and the first and second measure of statistical spread respectively.
- According to a third aspect of the present application, there is provided a computer program product, comprising a program of instructions

for a programmable processing system that, when executed by the programmable processing system, will cause the programmable processing system to execute the methods as disclosed herein.

5 Brief description of the drawing

These and other objects and advantageous aspects will become apparent from a description of exemplary embodiments using the following figures.

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| 10 | Figure 1 | shows a pattern detection system |
| | Figure 1a | shows a pattern detection system |
| | Figure 2 | shows a flow chart of video pattern detection |
| | Figure 3 | shows a decision tree |
| | Figure 4 | shows a graph of a decision function |
| 15 | Figure 5 | shows a flow chart of decision tree selection |
| | Figure 6 | shows a flow chart of a training process |
| | Figure 7 | shows action detection results |