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"Visual detection and tracking of human beings motion in surveillance systems"

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Motivation

- Security in public areas is an important issue nowadays.
- Video surveillance systems are powerful tools for monitoring, managing and strengthening of law enforcement in public areas.
- Human beings motion detection and tracking is useful for studying and analyzing their further activities.
- Automated visual detection and tracking facilitates the human beings work in the field.

Challenges

- Human beings class variations
- High variety of background
- Changes of environment illumination and colors
- Partial view of human beings (sometimes)

Motion Segmentation…

- Segmentation is the process of partitioning an image in segments.
- Pixels within a segment share certain visual characteristics.
- Motion segmentation is the process of separating the moving objects from the static background in the image.
- Areas with movement can be further analyzed.

Motion Segmentation…

- “Adaptive Gaussian Mixture Model” algorithm is used for motion segmentation in the sequential frames of the video.
- It supports illumination changes, repeated movements of the elements, slow moving objects, adding or removing objects from the scene etc.
- Two important parameters: α – the learning constant, T – portion of data accounted for the background.

Motion Segmentation

- A mixture of K Gaussian distributions models the value of each pixel through time.
- The current pixel value can match or not one of the existing K distributions.
- The background is modeled by choosing the best distributions until a certain portion T.
- The foreground pixels can be identified while each pixel process is updated.

Human Beings Detection

- Complex process with 2 steps
  - Feature vector extraction
  - Classification
- The classifier needs to be trained

Feature Vector Extraction

- “Histogram of Oriented Gradients” algorithm extracts the feature vector.
- It is applied only on the moving regions.
- Algorithm implementation
  - Gradient Computation
  - Orientation Binning
  - Descriptor Blocks
  - Block Normalization

Training and Classification…

- The feature vectors of positive and negative images are used for training.
- Support Vector Machine (SVM) is a training algorithm for the classifier.
- The classifier trained with SVM is binary, with two possible categories of classes.
- The classifier decides if the moving region contains or not a human being.

Training and Classification

- For large number of training examples, SVM training becomes complex
  - Long training time
  - High memory requirements
- SVMLight is an implementation of SVM but:
  - it passes the problem of large number of training examples
  - its memory requirement is linear with the number of training examples and support vectors

Human beings tracking…

- Tracking of detected human beings in motion is a difficult task.
- The main purposes of tracking are:
  - setting a correspondence between moving human beings in consecutive frames.
  - gathering temporal information about trajectory, speed, direction, etc. of human beings in motion.

Human beings tracking…

- Tracking can be done by using:
  - Kalman Filter
  - Extended Kalman Filter
  - Particle Filter

Human beings tracking…

- Kalman Filter
  - Non constant speed motion is modeled through Gaussian noise
  - Predicts human being position in the consecutive frame
  - Optimal estimation for linear systems with Gaussian noise
  - Problem: human beings movement is not linear

Human beings tracking

- Extended Kalman Filter
  - Models nonlinear systems with Gaussian noise
  - It's a standard in nonlinear state estimation
  - Advantage: Human beings motion is nonlinear
- Particle Filter
  - Models nonlinear systems with possible non Gaussian noise
  - It can be more accurate than EKF

Conclusions

- Acquired videos by a static camera are processed.
- Adaptive Gaussian Mixture Model models the background and extracts moving regions.
- Histogram of Oriented Gradients extracts feature vector.
- SVMLight trains the classifier for the detection.
- Kalman Filter, Extended Kalman Filter, Particle Filter are the 3 methods of tracking.
- The accuracy of the tracking methods is estimated.
- MATLAB programming is used for the implementation.
- The accuracy of the whole system is estimated and analyzed for further improvements.
- The main goal is to achieve a high rate of accuracy in detection and tracking.

Thank You!!!

Questions…?