Pattern Recognition

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Reference paper

- Human Action Recognition using Depth Maps
  - Vennila Megavannan
  - Bhuvnesh Agarwal
  - R. Venkatesh Babu

Roadmap

- Dataset
- Action Representation
  - Motion history image
  - Average Depth Image
  - Depth Difference Image
- Implementation
  - Tools
  - Feature extraction results
- Results
  - Training
  - Testing

Data Information

- Dataset
  - Different kind of motion videos
    - Bend, bowling, box, jump, kick, squat, strength, swim, trumble, wave
  - Each video contains 19 frames
  - Depth Image

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Motion History Image

$$B(i,j,t) = \begin{cases} 1, & \text{if } D(i,j,t) > 0, \\ 0, & \text{otherwise,} \end{cases}$$

$$B_{diff}(i,j,t) = B(i,j,t) - B(i,j,t-1)$$

$$I_{mhi}(i,j,t) = \begin{cases} \tau, \text{if } B_{diff}(i,j,t) = 1, \\ \max(0, I_{mhi}(i,j,t-1) - \tau) \text{ o.w,} \end{cases}$$

$$I^k_{mhi} = I_{mhi}(i,j,k+N-1)$$

Average Depth Image

$$I^k_{avg} = \frac{\sum_{t=k}^{k+N-1} D(i,j,t)}{\sum_{t=k}^{k+N-1} B(i,j,t)}$$

Depth Difference Image

$$I^k_{max}(i,j) = \max\{D(i,j,t) : D(i,j,t) \neq 0, \\ \forall\ t \in [k \ldots (k+N-1)]\}$$

$$I^k_{min}(i,j) = \min\{D(i,j,t) : D(i,j,t) \neq 0, \\ \forall\ t \in [k \ldots (k+N-1)]\}$$

$$I^k_{diff} = I^k_{max} - I^k_{min}$$

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Information

- Tools
  - Visual Studio 2010
  - Opencv 2.4.10
  - LibSVM 3.2.1

Action Representation

- Cut all videos into frames
- Bounding box features
  - Compute depth difference image(DDI) for each class
  - Extract 108 features from different windows each of different size

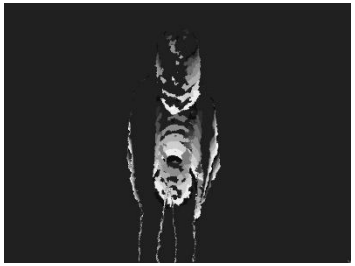
$$F1_k^b = \max_{(i,j)\in R_b} \{I_{diff}^k(i,j) : I_{diff}^k(i,j) \neq 0\},$$

$$F2_k^b = \min_{(i,j)\in R_b} \{I_{diff}^k(i,j) : I_{diff}^k(i,j) \neq 0\},$$

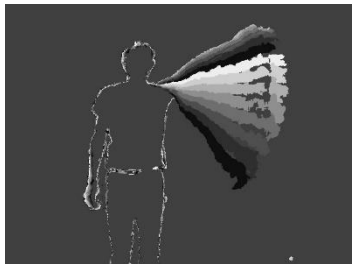
- Hu Moments features
  - Compute motion history image(MHI) for each class
  - Compute for each class average depth image(ADI)
  - Extract 14 features from depth different image

Action Representation

- MHI



bend



bowling

box

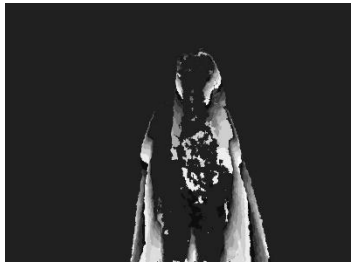
jump

kick

squat

strenth

swim



tumble

wave

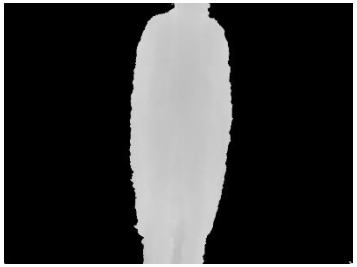
Action Representation

- ADI

bend

bowling

box



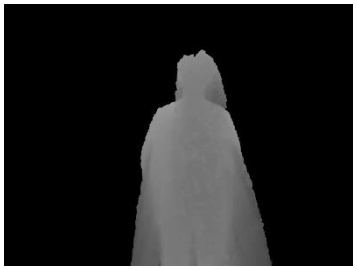
jump

kick

squat

strenth

swim



tumble

wave

Action Representation

- DDI

bend

bowling

box

jump

kick

squat

strenth

swim

tumble

wave

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Training & Testing

- SVM Type
  - C-SVC (multi-class classification)
- Kernel
  - Linear
    - 108(DDI)
      - Cross Validation Accuracy = 95.1872%
      - Accuracy = 100% (20/20) (classification)
    - 14
      - Cross Validation Accuracy = 23.5294%
      - Accuracy = 25% (5/20) (classification)

Training & Testing

- SVM Type
  - C-SVC (multi-class classification)
- Kernel
  - polynomial
    - 108(DDI)
      - Cross Validation Accuracy = 94.1176%
      - Accuracy = 100% (20/20) (classification)
    - 14
      - Cross Validation Accuracy = 10.1604%
      - Accuracy = 10% (2/20) (classification)

Training & Testing

- SVM Type
  - C-SVC (multi-class classification)
- Kernel
  - RBF
    - 108(DDI)
      - Cross Validation Accuracy = 20.3209%
      - Accuracy = 20% (4/20) (classification)
    - 14
      - Cross Validation Accuracy = 22.9947%
      - Accuracy = 25% (5/20) (classification)

Training & Testing

- SVM Type
  - C-SVC (multi-class classification)
- Kernel
  - 108(MHI)
    - Linear
      - Cross Validation Accuracy = 97.3262%
      - Accuracy = 95% (19/20) (classification)
    - Polynomial
      - Cross Validation Accuracy = 96.7914%
      - Accuracy = 95% (19/20) (classification)

Training & Testing

- SVM Type
  - C-SVC (multi-class classification)
- Kernel
  - 108(ADI)
    - Linear
      - Cross Validation Accuracy = 10.1604%
      - Accuracy = 10% (2/20) (classification)
    - Polynomial
      - Cross Validation Accuracy = 10.1604%
      - Accuracy = 10% (2/20) (classification)

Training & Testing

- SVM Type
  - C-SVC (multi-class classification)
- Kernel
  - Combined
    - Linear
      - Cross Validation Accuracy = 97.861%
      - Accuracy = 100% (20/20) (classification)
    - Polynomial
      - Cross Validation Accuracy = 96.2567%
      - Accuracy = 100% (20/20) (classification)
    - RBF
      - Cross Validation Accuracy = 18.7166%
      - Accuracy = 25% (5/20) (classification)

Thank you !