Progress Journal

Meeting Week 1 (Friday, Feb 21)

Attendees: Whole Group
Discussed:

1. Explored potential deep learning and traditional computer vision methods applicable to action and activity recognition.
2. Reviewed methods for motion representation, feature extraction, and classification.
3. Divided work for literature review.
4. Analyzed research papers and studies related to action recognition. Identified key distinctions between traditional handcrafted feature-based methods and modern deep learning-based techniques.
5. Through our research and discussion we found that traditional methods relied on handcrafted features, while recent advancements leverage deep learning for improved accuracy.
6. For next week's meeting, agreed to research and bring at least 2 research papers related to traditional computer vision methods involving action and activity recognition, and 1 paper related to deep learning based methods

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Meeting Week 2 (Friday, Feb 28)

Attendees: Whole Group
Discussed:

1. Discussed traditional computer vision and deep learning methods used for action and activity recognition found in the papers we brought.
2. Identified additional research studies and literature on motion descriptors, feature-based methods, video retrieval, and deep learning techniques.
3. Examined benchmark datasets suitable for our approach, considering factors like action diversity, annotation quality, and video resolution.
4. Through our combined research, we found that traditional methods such as optical flow, offer interpretability but struggle with complex motions. Meanwhile, deep learning techniques are an improvement over traditional methods as they improve recognition accuracy by automatically learning features.
5. Agreed on emphasizing computational efficiency and interpretability, leading to the decision to explore Motion History Images (MHI), Optical Flow, Hidden Markov Models (HMMs), and HOG for feature extraction.
6. For next week we agreed to look into MHI, Optical Flow, and HOG and bring at least 2 research papers related to these subjects

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Meeting Week 3 (Friday, March 7)

Attendees: Whole Group
Discussed:

1. Explored areas for improvement in video retrieval techniques related to action recognition.
2. Identified methods to improve feature extraction using Optical Flow, temporal pyramids and HOG.
3. We also identified the need for robust preprocessing to handle noise and variations in motion representation as this has posed a problem in relevant systems in the past
4. Discussed the integration of temporal information to enhance recognition accuracy.
5. For next week, review papers “Motion history image: Its variants and applications” and “Action Recognition Using Motion History Image and Static History Image-based Local Binary Patterns” and be ready to discuss

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Meeting Week 4 (Friday, March 14)

Attendees: Whole Group
Discussed:

1. From the 2 papers we found that the MHI captures the temporal history of motion by highlighting moving regions in an image sequence, with intensity values representing recency of motion. MEI complements this by indicating regions where motion has occurred without temporal ordering.
2. Further improved our feature extraction pipeline by continuing to experiment with Optical Flow and HOG.
3. Began initial dataset preprocessing and feature extraction analysis.
4. We found that many models perform well on benchmark datasets but struggle in real-world environments.
5. We found that optical flow is beneficial for capturing motion direction and magnitude, which could enhance motion weighting in MHI-based systems. However, it also introduces challenges such as increased computational complexity, sensitivity to noise, and difficulties in handling abrupt motion changes.
6. For next week, find GitHub repo, or research paper you think we can use as a basis for our project
7. For next week, research applications of video retrieval in action and activity recognition. Find and add video retrieval system/structure(dependancies, etc) to GitHub.
8. Find similar systems that do close to what we’re trying to do, and identify possible/alternative areas of innovation (what our project can uniquely offer)

Meeting Week 5 (Friday, March 21)

Attendees: Whole Group
Discussed & Todo List:

1. Explore object tracking integration with the existing base project and determine suitable algorithms for implementation.
2. Research applications of video retrieval in action and activity recognition.
3. We analyzed similar systems to identify gaps and areas for innovation unique to our project. Sandeep Srinivasan's project on GitHub used similitude moments on MHI and MEI for action recognition but struggled with actions involving motion across the scene such as running, due to MHI similarity. The system's accuracy (44.4%) suffered because MHIs for these activities were too visually similar, leading to misclassification. We will attempt to improve on this by combining Optical Flow with MHI.
4. Decided to explore a pipeline using MHI combined with handcrafted descriptors for improved action recognition.
5. Tested using Hidden Markov Models (HMMs) for temporal sequence classification. We found that this method has better temporal modeling. We also found that by training HMMs on sequences from different individuals and testing on unseen subjects, we were able to demonstrate the model's ability to generalize across different people performing the same action.
6. We also found that HMMs struggled with Visually Similar Actions. Certain actions like walking, running, and skipping had similar MHIs, leading to high misclassification rates because their temporal progressions overlapped in feature space.
7. We also found that improving upon similitude moments by using HMMs for temporal modeling still relies on Hu moments, which may not capture the finer details of shape deformation in motion. Actions that involve complex limb movement but similar overall motion shape (e.g., one-handed vs. two-handed wave) still pose significant classification challenges.
8. We also found that by enhancing the original method with Optical Flow-Weighted MHI, faster and stronger movements were identified more clearly. Similar looking actions were also distinguished at an increased rate
9. We plan to enhance our Optical Flow-Weighted MHI with temporal pyramids and expect to see better results
10. For next week, begin documentation, and final project report. Look for a way to improve misclassification rates of HMMs

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Meeting Week 6 (Friday, March 28)

Attendees: Whole Group
Discussed:

1. We found that optical flow primarily captures local motion vectors but does not inherently distinguish between different types of actions when used alone. When combined with MHI, similar-looking motion templates for distinct actions, such as running vs. skipping, can lead to misclassification.
2. We tested combining Optical Flow-Weighted MHI with Temporal Pyramid and found an increase in motion detection and similar action distinguish rate
3. We found that enhancing the original method using a DHMI based method led to a decrease in performance. We found that there were extreme misclassifications, and 100% of wave 2 samples misclassified as bend.