2021 NSF CYBER-PHYSICAL SYSTEMS PRINCIPAL INVESTIGATORS' MEETING

Cyber-Physical Sensing, Modeling, and Control with Augmented Reality for Smart Manufacturing Workforce Training and Operations Management

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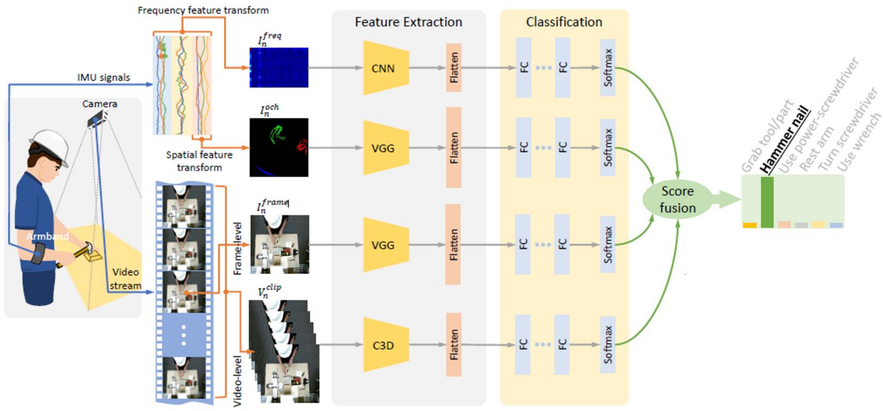
Challenge:

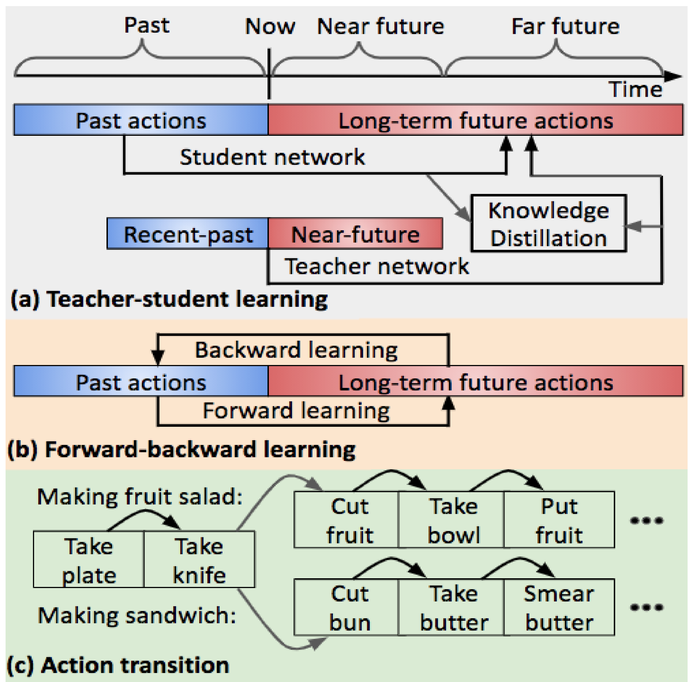
- How to use multi-modal sensing for human-centered action recognition?
- How to fuse multiple classifiers to develop a more reliable and robust action recognition system?
- How to obtain an efficient and accurate network for long-term future action anticipation?

Solution:

- Introduced a method of weakly-supervised Action Completeness Modeling with Background Aware Networks (ACM-BANets).
- Designed a method of fusion using a weighted average of selected classifiers to maximize the performance of individual workers.
- Built a collaborative forward and backward teacher-student learning framework, and introduced a transition loss for modeling the sequential actions.



Our multi-modal sensing approach for worker activity recognition



Main ideas of our proposed future action anticipation

Scientific Impact:

- Our ACM-BANets outperforms the current weakly-supervised temporal action localization methods;
- Our method of fusion modeling and refining has consistently achieved improvement in recognizing various actions of different assembly workers;
- Our method of collaborative forward and backward teacher-student learning outperforms all of the latest state-of-the-art action anticipation methods.

Broader Impact:

- Published 4 journal papers, 4 conference papers, and 1 book chapter in the past year.
- Trained 8 Ph.D. students and 5 undergraduate students.
- Performed convergent research with PIs from multiple disciplines.
- Developed technologies helpful to future manufacturing workforce.