Seminar Presentation

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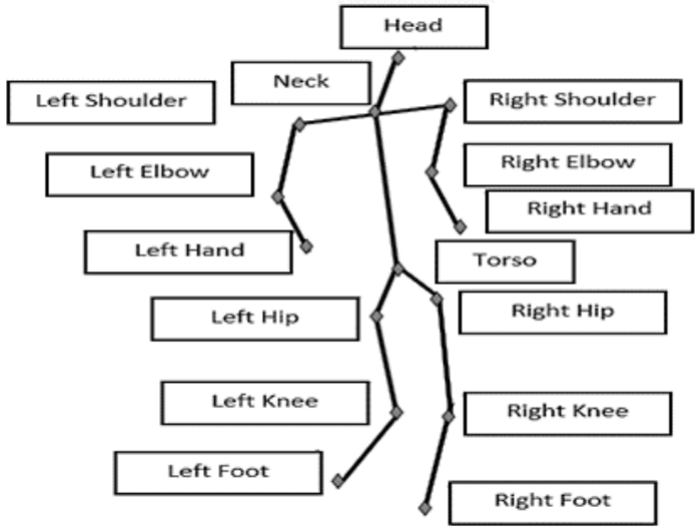
Paper

- Human Activity Recognition Based On Convolutional Neural Network
- Abstract Summary- Recognize human action using RGBD cameras, a convolutional neural network, and novel entropy approach to identify important joints

https://people.cs.pitt.edu/~chang/153/kinectIntro.html

Introduction

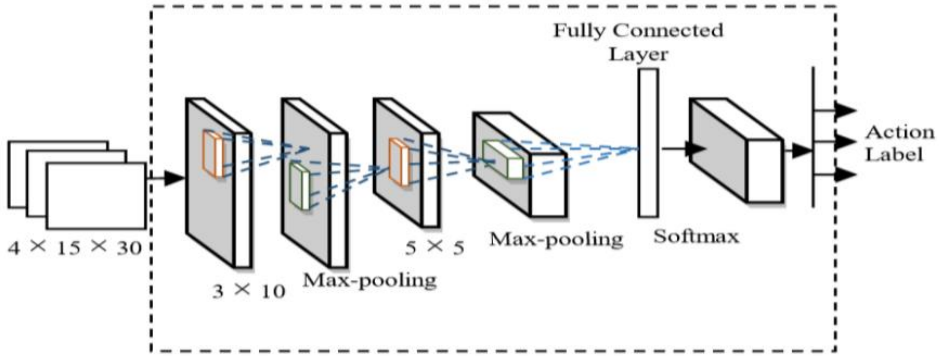
- Human Action Recognition- used for video surveillance, health care, sports analysis, etc.
- Usage of Kinect camera records depth map, can find skeleton position
- Paper seeks to extract invariant characteristics of humans from 3D skeleton joints to recognize everyday actions (drinking, working on computer, etc)- CAD-60 Dataset



Xu, Wenchao, et al. “Human Activity Recognition Based On Convolutional Neural Network.” 2018 24th International Conference on Pattern Recognition (ICPR), July 2018, doi:10.1109/icpr.2018.8545435.

Convolutional Neural Networks

- Deep Learning style utilized in computer vision
- Input: input vector was a 3D vector with joint attributes (size 4), number of joints (size 15), and number of frames (30)
- 3 Main Parts



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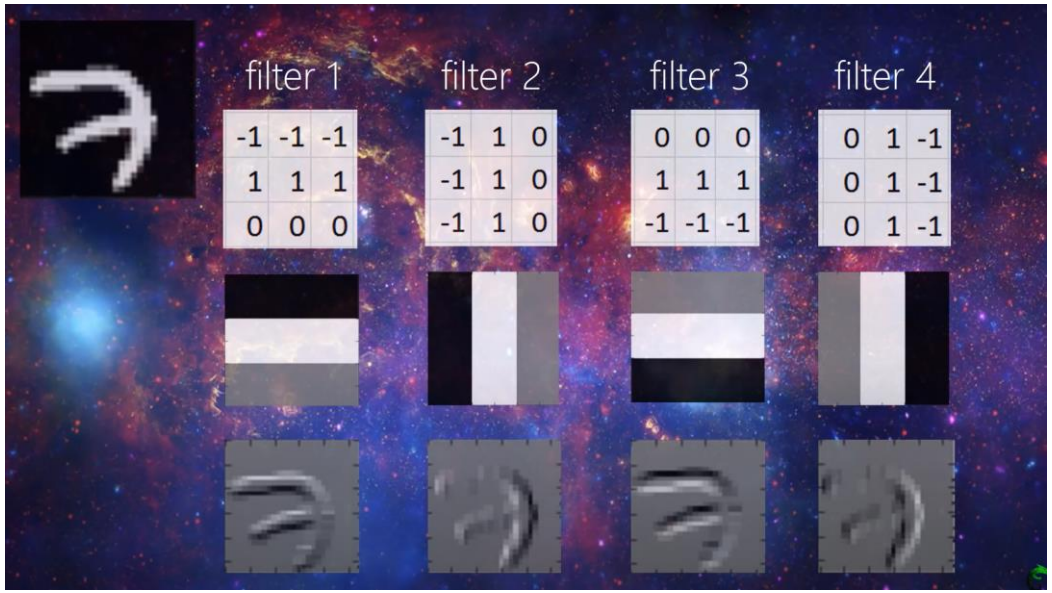
Convolution Layer

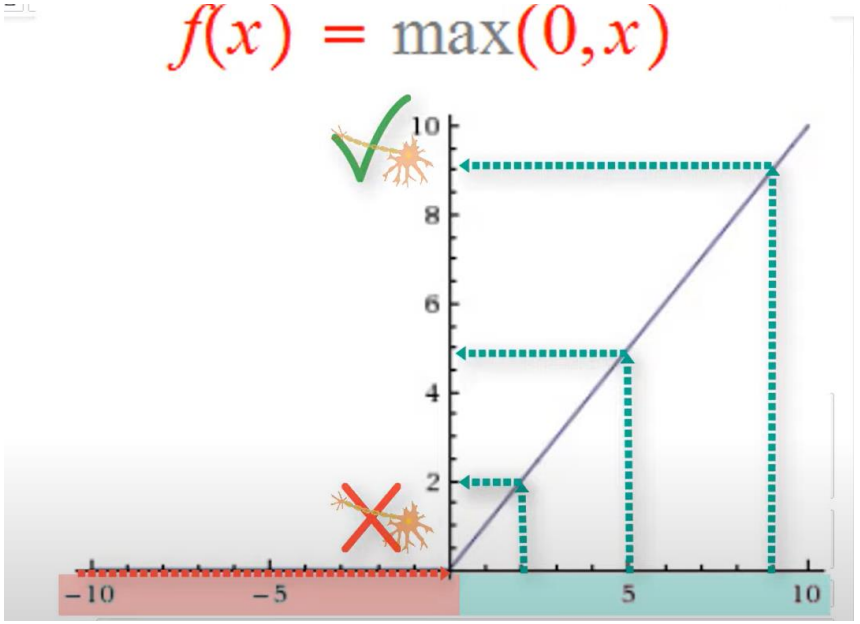
- Sweeps out features from an image, tries to learn from it, computes dot product between a filter value and image pixels (3x10 in the paper)
- Detects patterns in an image through convolution



https://www.youtube.com/watch?v=YRhxdVk_sIs&ab_channel=deeplizard

Activation Function

- In a neural network, the activation function of a neuron defines the output of the neuron given a set of inputs
- Biologically inspired by activity in brain where some neurons fire when activated by stimuli
- Paper uses the Rectified Linear Unit function- f(z) = max(0,z), which essentially makes it such that the more positive the neuron, the more activated



https://www.youtube.com/watch?v=m0pIlLfpXWE&ab_channel=deeplizard

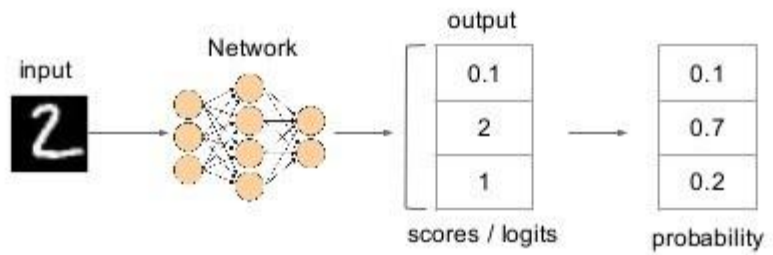
Softmax Activation Function

- Assigns a probability for each class
- Outputs final classification (brushing teeth, cooking, etc) from the CAD-60 dataset

- Softmax function

scores (logits)

$$S(l_i) = \frac{e^{l_i}}{\sum_k e^{l_k}}$$



https://www.slideshare.net/xavigiro/loss-functions-dlai-d4l2-2017-upc-deep-learning-for-artificial-intelligence

Shannon Entropy Formula

- Wanted to see if neglecting some joints makes it easier to recognize actions
- Higher entropy = more contribution

$$H(X) = -\sum_{i=0}^{N-1} p_i log_2 p_i$$

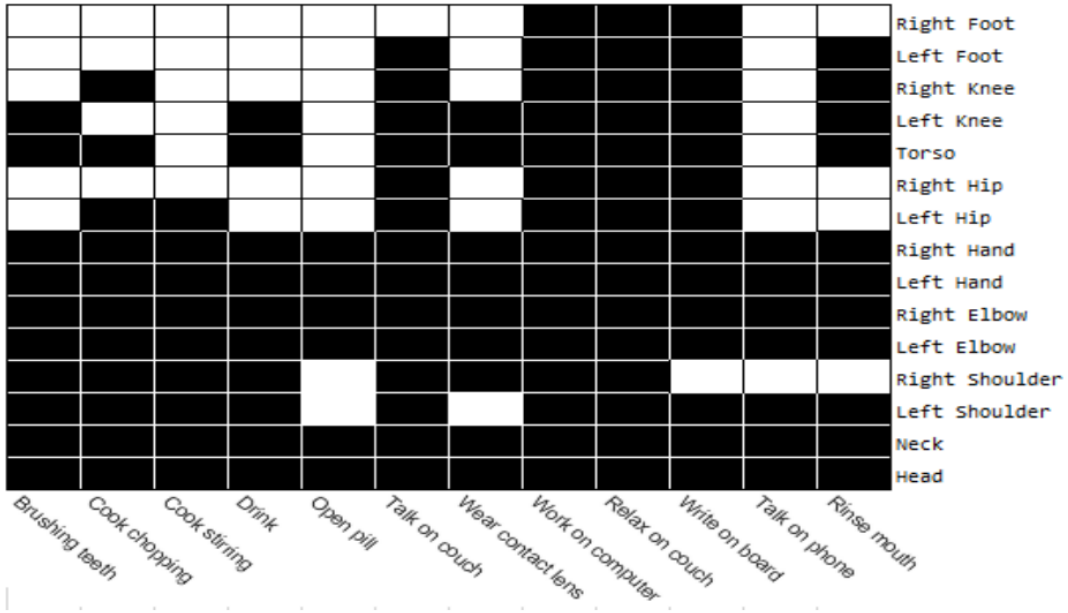


Fig. 4. The informative joints for the CAD60 dataset. The dark block indicates the selected informative joints.

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Experiment

- Trained CNN to analyze human posture
- Use CNN to examine accuracy using all joints
- Comparison when eliminating irrelevant joints based on Shannon Entropy
- Dataset 80% training, 20% testing

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Results

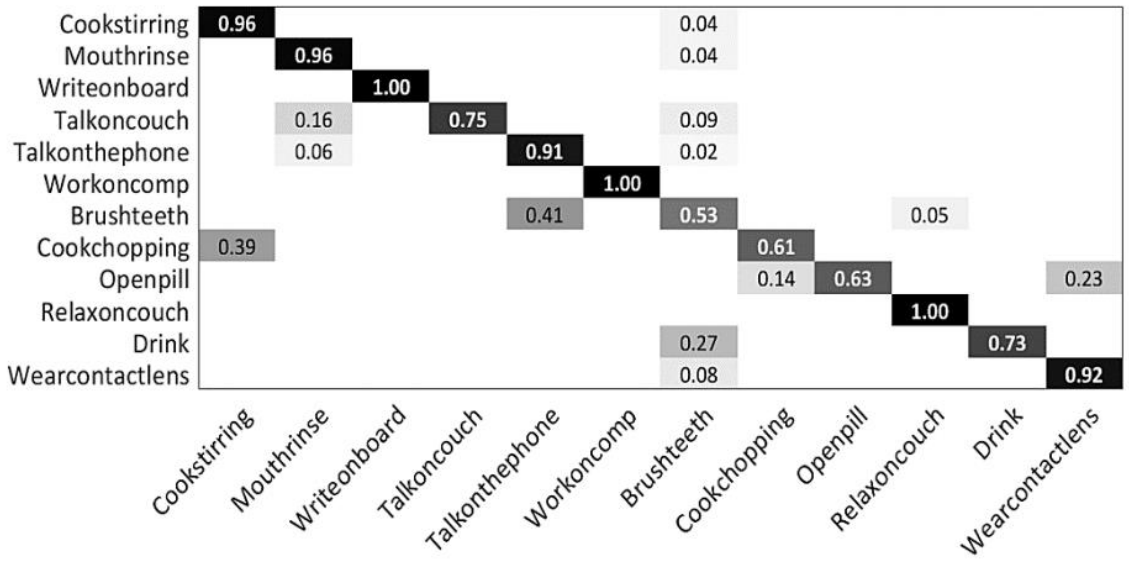

Fig. 6. Confusion matrix for all 15 skeletal joint points with accuracy 82.96%.

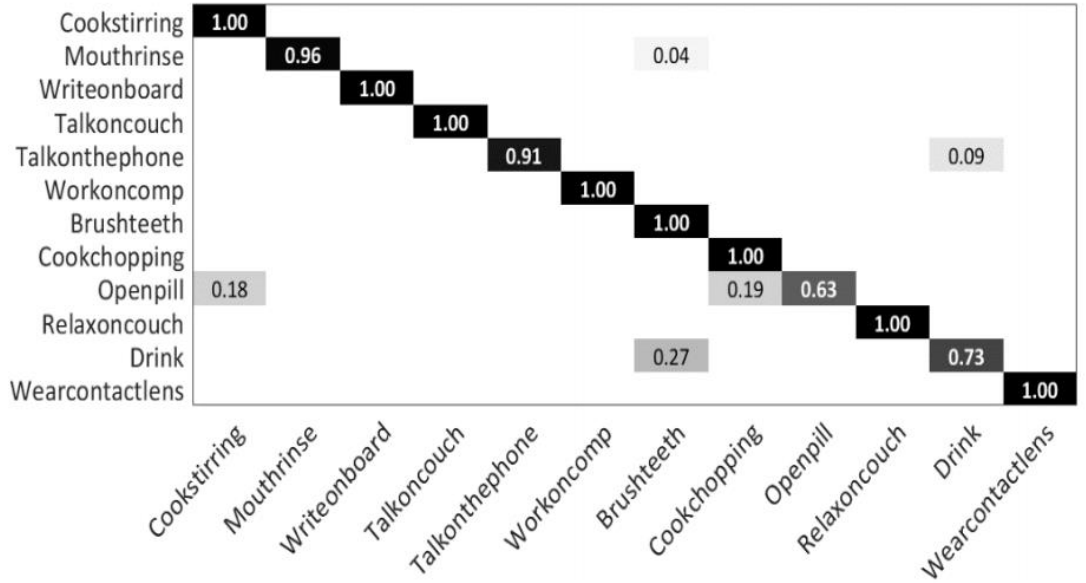

Fig. 7. Confusion matrix for selected skeletal joint points with accuracy of 94.16%.

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Applications to Ergonomic Assessment

- Consider using a CNN for our own recognition of posture (maximum deliverable)
- Confirms that recognizing individual joint locations is much easier than trying to analyze human actions
- Brings up potential problems regarding background objects/lighting in the paper that will also be issues for our project

References

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