

Finger Motion EMG Signal Classification Based on HTM (Hierarchical Temporal Memory) Technique

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IN recent years, there has been a tremendous interest in introducing intuitive interfaces that can recognize the user's body movement and translate them into machine commands. Various biomedical signals acquired from tissues, organs, and/or cell systems like the nervous system are proposed as drivers of human computer interface. Electromyogram signal (EMG) is the small electrical impulses that are generated by muscular activity. Some of the applications of EMG include physical rehabilitation, biomechanics, and ergonomics. EMG is also used in diverse applications such as operating prosthesis limbs, robotic devices, and input interface for small devices like mobile phones or PDAs [1,2]. The recent research and developments in the wireless sensor networks have a great impact on many aspects of medical care. For example, by outfitting patients with wireless, wearable vital sign sensors, collecting detailed real-time data on physiological status can be greatly simplified [3]. In this research a wireless EMG amplifier circuit is successfully designed and fabricated to capture the EMG signals from a muscle responsible for finger movement. The Hierarchical Temporal Memory (HTM) algorithm is used to classify and recognize EMG signals resulting from opening or closing fingers. The Hierarchical Temporal Memory (HTM) is a model that replicates the structural and algorithmic properties of the neocortex, which is capable of performing tasks such as visual pattern recognition, understanding spoken language, recognizing and manipulating objects by touch[4].

Figure 1 shows the HTM network structure used in this study. The network is organized in a 2 level hierarchy which is composed of classifier node, data sensor and a category sensor. The data sensor receives EMG dataset input while category sensor receives category data input for the HTM network respectively. The whole input data is distributed amongst the leaves of the tree. After an initial processing, the data results are passed upwards to its parent. This process repeats until the information reaches the top of the tree. The root is also called classifier node because it will output the result of the inference and also, it receives the categorical information during the process of supervised learning. HTM structure as well as memory is hierarchical in both space and time. The benefit of hierarchical organization is that it significantly reduces training time and memory usage because patterns learned at each level of the hierarchy are reused when combined in novel ways at higher levels.

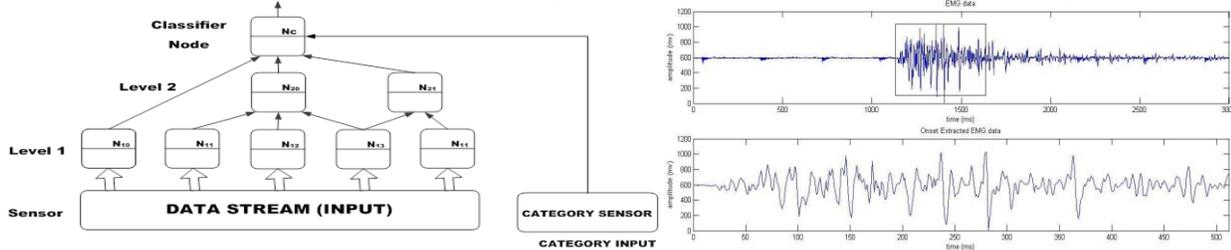


Figure 1. Network structure of HTM and the collection of EMG signals from finger motions.

The EMG device is installed on the right forearm for experiments. The classifier is trained with 200 repetitions of each closing and opening movement of ring fingers. Real time classification is performed with 100 total movements, which included 50 of each close and open movement, in random order. Figure 2, shows one episode of data after onset detection. The experimental results show that the HTM classifier successfully classified open movement 46 times out of 50 actual movements with accuracy for open movement being 92% and close movement 48 times out of 50 actual movements with accuracy for close movement being 96%. The overall accuracy of HTM classifier is 94%.

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This work was supported in part by the US NSF ERC for Sensorimotor Neural Engineering Grant.

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