

Development of Surface - EMG Based Single Finger Movement Identification and Control for a Bionic Arm



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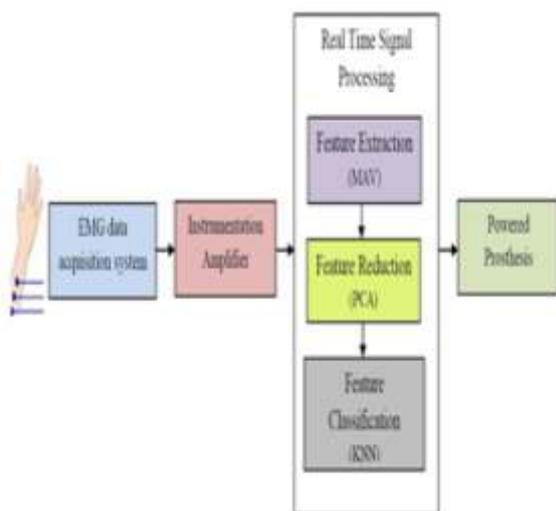
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Abstract:

The number of amputees in worldwide are estimated to be around 650 million and nearly 10% of the amputee population resides in India. Hence there is an acute need for the development of a low cost, automated Bionic arm. Bionic arm is an artificial arm that provides many of the human arm features including integration with the nervous system for amputees. Invasive and non invasive methods are used to collect the EMG signal from amputees. In spite of difficulty caused by invasive methods, non invasive methods are being opted in today's recent Bionic Arms. Therefore to overcome the drawback of non invasive methods proper classification algorithms has to be chosen for controlling individual finger movements in Bionic Arm.

In this project, initially various feature extraction; reduction and classification algorithms are implemented in MATLAB on EMG data of different subjects which is available from Ninapro database. From the results obtained, MAV algorithm for feature extraction, PCA algorithm for feature reduction and KNN algorithm for feature classification are chosen since they gave more accuracy compared to others after implementing on EMG data of different subjects. Simulink Model has been developed for the chosen algorithms from the MATLAB code. 'C' code is generated from the developed Simulink Model with the help of embedded coder and is ported on to the DSP processor through CCS which serves as interface between Simulink and processor. Finally code generated in CCS is optimized and dumped on the processor through JTAG Emulator. MAV, PCA and KNN algorithms are implemented on ATmega 328 controller to which Bionic Arm is interfaced.

By employing MAV algorithm for feature extraction, PCA algorithm for future reduction and KNN algorithm for feature classification 95% accuracy is achieved for controlling individual finger movements in Bionic Arm after implementing in MATLAB. Response time between grasp and release actions of fingers in Bionic Arm obtained after implementing on processor is less than 1 ms where as on controller is less than 3 s.



Block diagram for finger movement control in bionic arm