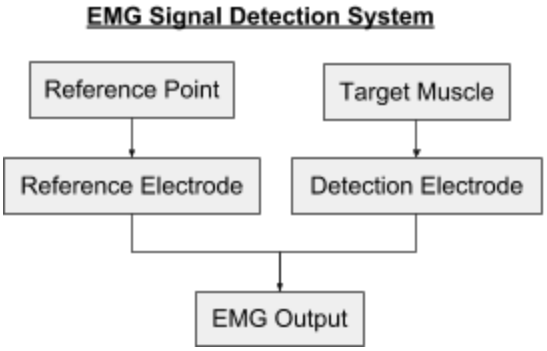
Conceptual Design - Electromyogram (EMG) Signal Detection

Conceptual design is an address to the client's problem statement as well as an outline of the systems and functions of the product. The purpose of the conceptual design process is to allow the generation of possible concepts that act as a means of solutions to the problem statement while adhering to its constraints. Therefore it is a significant step in the design process where without a conceptual design process, there can be no ideas generated and therefore no successful product.

Brainstorming is a conceptual design method used in the individual design of a system for EMG signal detection. The brainstorming of EMG signal detection revolved around the flow of contiguous ideas, where key words and questions promoted possible solutions.



"How to detect EMG?" was the first question to consider and the most important as the application of EMG to activate and control the bionic hand was the given constraint from the problem definition. Surface detection electrodes must be placed where the motor unit action potential (MUAP) can be detected on the skin - and reference electrode placed somewhere on the body that is electrically inert. A wire attaches the electrode to an EMG output where it is processed. The brainstorm led to the idea of using the bicep and tricep *(making use of the upper arm of a lower arm amputee)* to activate the bionic hand and the use of "*inactive muscles"* as the reference point since it should be electrically inert. However, these are only suggestions and optimal placement of electrodes can only be decided through experimental testing.

The brainstorm also allowed insight to any possible *"problems"* in detecting EMG which led to two more contiguous ideas: *"impedance"* and *"noise"*. Impedance will decrease the amplitude of the signal and could be due to tissues in between muscle and electrode, layers of skin, hair, and dirt or foreign particles on the skin. Noise is the interference of unwanted signals superimposed with the MUAP signal. Noise could be due to external EMR in lights and electronics, and cross-talk (when an untargeted muscle's MUAP can cause interference).

How can noise/ impedance be reduced? Impedance can be reduced through optimal placement of electrodes, the use of amplifiers and removal of hair and dirt on the skin by shaving, waxing and thorough cleaning. The optimal placement of electrodes routed back to "*how to detect EMG"* when considering where to place electrodes; adding the consideration of *"boney, non-muscular"* skin surfaces for reference points. There were many contributions to noise. To reduce noise caused by external EMR from lights and electronics, shielding cables and band filters was considered. For noise caused by cross-talk, there should be a consideration in the optimal placement of electrodes where adjacent muscles will interfere with the MUAP and the minimisation of unnecessary muscle activation from adjacent muscles.