CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Human daily life involves many physical and mental activities which mostly relate with the movement of muscle and tendon in whole body muscular system. Movement of muscle is significantly be influenced by on the muscle contraction as movement while exercise, working or writing that commonly occurs at upper limb muscle. When the muscles are not able to maintain its requirement output power while contraction, fatigue will happen.

Muscle fatigue is one of a muscular disorder that occurs due to the excessive muscle contraction at a prolonged times even it happen with small load. The asset of muscle contraction is depend on the numbers and sizes of active motor unit (MU), stimulation rate of MU and the muscle fibers types. To evaluate the muscle fatigue in different medium, surface electromyogram (sEMG) is the most consideration to measure the relative change about the muscle state condition. There are different parameters that could be used to extract the myoelectric activity over sEMG signal. Root-mean-square (RMS) is the common parameter features which could increase the sEMG signal amplitude.
1.1.1 Electromyography

Electromyography signal is a result of detecting, processing and evaluating the electrical activity (electromyogram or EMG) in the muscle that produced from muscle contraction. The muscle signal are detected by an electrodes that connecting with simple sensor that could assess the motor unit in the fiber during contraction occurs. The composition of EMG signal could be recognizes based on knowledge in anatomy and entire neuromuscular system representative.

In general, there are two types of EMG signal, which are surface EMG (sEMG) and intramuscular EMG (Chowdhury et al., 2013). Surface electromyogram (sEMG) is the electrical activity that been recorded during the muscle activation which is a combination of tissue-filtered motor unit action potentials (MUAP) that generated by an active motor unit (Arjunan, Kumar, & Naik, 2014).

Definition of motor unit is a motor neuron that all fibers innervate on it. While in performing an intramuscular EMG, there an insertion of needle together with an electrode connected with two fine wires into the muscle tissue through the skin. The action potential called impulse has been transmits through motor neuron to the muscle. Motor end plate is the region where nerve contact the muscle and all the action potential are response with the muscle fiber and cause an electrical activity that known as motor unit action potential (MUAP) (Zhou, Chen, Ma, & Zheng, 2011). This signal activity is the signal that will be evaluate during an EMG process.

1.1.2 Electrode

There are two types of electrodes, intramuscular electrodes or invasive electrode that used by insertion of a needle across the skin and surface electrode which is noninvasive electrode that attached on the skin. Needle with silver (Ag) wire are tie together to detect the electrical activity during contraction with low amplitude and low speed muscle activity result. Mostly, this approach is used for medical research or clinical diagnosis for neurophysiological evaluation.

In this study, a surface electrode will be used for sEMG evaluation because the signal is easy to record while accessing the muscle fatigue that occur on the upper limb.
that result from estimating the muscle contraction during the changes in muscle state condition (Arjunan et al., 2014). Surface electrode is commonly made from round metal plate in small millimeters diameter or in rectangular of silver chloride (Ag/Cl). Double-face adhesive tape are fixed with the electrodes when place it on the skin surface with the estimation of muscle contraction phase will occurs in parallel orientation with muscle fibers.

1.1.3 Upper limb muscle

On the arm, there are four muscles that attached on it which are biceps brachii, brachialis and coracobrachialis where placed on anterior compartment and another one triceps muscle which located on posterior compartment. Biceps and triceps muscle are work together to move the forearm in a way of contraction on the biceps and flexes it to move towards the humerus and shoulder. While triceps is an opposite one that will contract towards ulna and get away from the humerus in lower down the arm. However, they are not move itself but with the assistance from the small muscle such as brachialis and brachioradialis that important to initiate and stabilize the arm when its movement ("Anatomy & Physiology," 2015).

1.1.4 Muscle Fatigue

According to Zhou, fatigue is consist of systemic and local fatigue where the systemic fatigue are cause from an excessive physical work then related with mental and disease disorder while local fatigue are happen due to the long working hours or bad body posture while working such as while seating on the chair (Zhou et al., 2011). The fatigue occurs when body are cannot supply enough energy to meet the demand and decrease the body performance ability during physiological activities.