2017 International Bionic Innovation Competition

A Cyborg Hand Driven by Vitro Skeletal Muscle

Abstract

For the past few years, tissue culture technique in vitro has developed rapidly, which makes people think about the possibility of utilizing muscle as the power of machine, especially for bionic machinery, such as a mechanical hand. Having all these advantages, muscle tissue may be considered as a new direction of green power sources. In this project, a cyborg hand driven by vitro skeletal muscles of frog is designed, combined with an initial control part.

Methods

The design is divided into three parts: drive module, execute module and control module. The schematic diagram is shown in Fig.1:

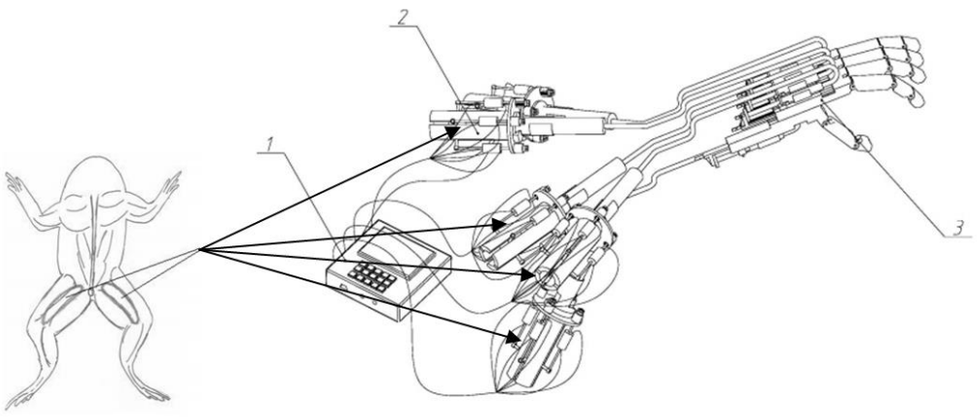

Fig.1 1. Execute module 2. Drive module 3. Control module

As the drive module, the skeletal muscle of frog is chosen to be the power source. The muscle is taken from what is shown in Fig.2. Based on the characteristics of muscle that it contracts under electrical stimulation, an electrical stimulator is connected to the muscles by inserting electrodes to drive the device.

Fig.2 Skeleton muscle of frog adopted

Results

This design is concerning a cyborg hand driven by vitro skeletal muscles of frog. The mechanical fingers can realize the flexion and extension motion and give a rapid response to the stimulation signal. In addition, a primary control that the cyborg hand can follow the simple motions the controller does.

As the execute module, the mechanical hand is fabricated by 3D printing. Each finger's motion is driven by a pair of muscles: one for its flexion and one for its extension, connected by ropes, which means once stimulated by current, the muscle contracts and pulls the rope to drive the finger into flexion; the same happens when extension. The connection between the execute and drive module is shown in Fig.3:

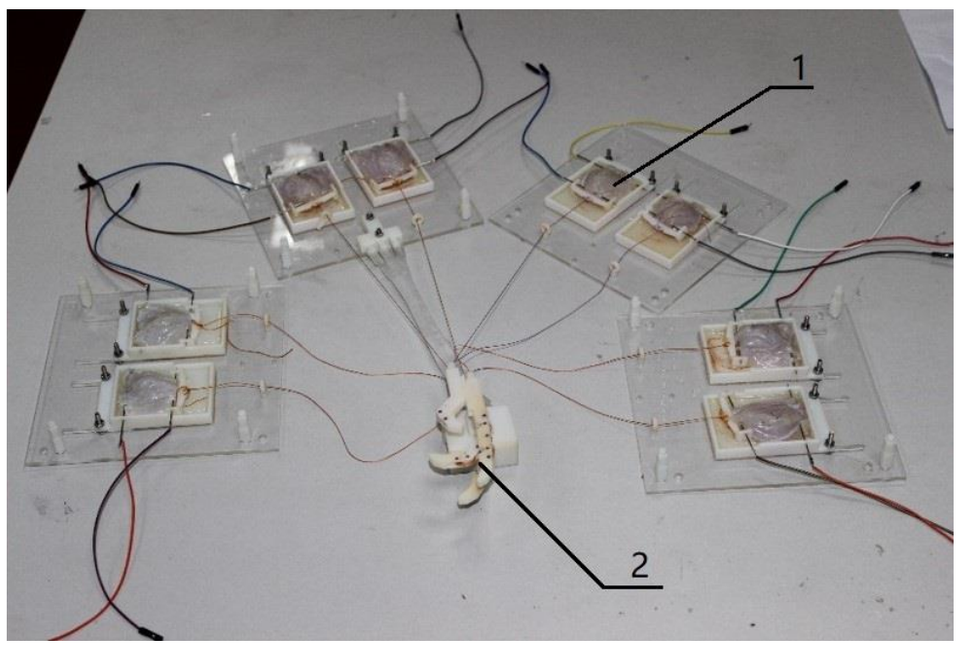

Fig.3 1. Drive module 2. Execute module

As for the control part, an armlet is utilized to collect the EMG of the controller's arm to realize the recognition of the controller's motion and to translate it into the control instruction to the functional electrical stimulator, therefore realize the "muscle to muscle" control.

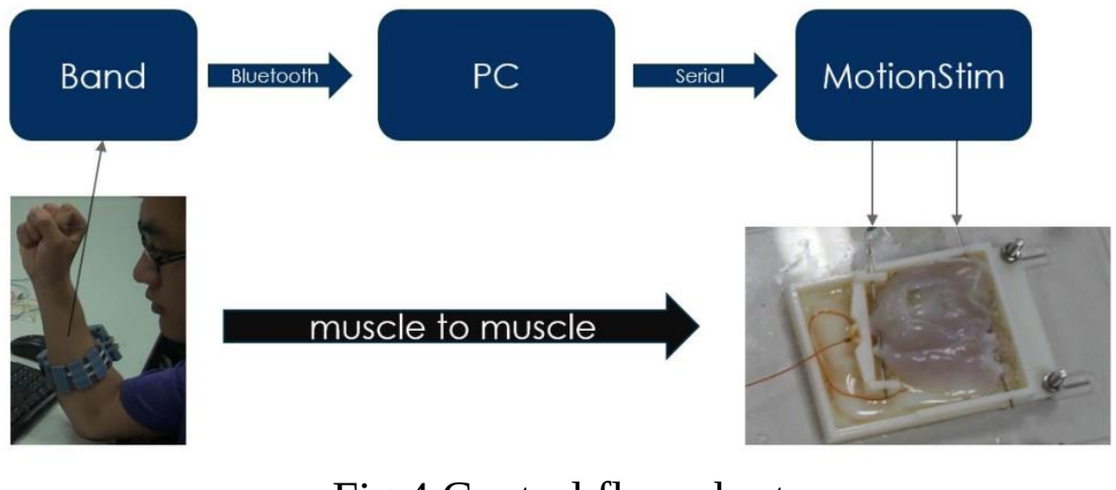

Fig.4 Control flow chart

Until now, the control is still staying at the open loop phase. A close loop system is previewed to control more precisely the motion in the future, for example, the control of motion speed and angle of the finger.

Patents

- 活性离体骨骼肌驱动的生机电一体化假手:, CN104511894A[P]. 2015.