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Electrical stimulation applications in functional activities

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ABSTRACT: It has now been widely used in research on stroke patients. It is for the regulations of the brain's neural plasticity have not yet quantified evidence. It is worth further exploration. It is an integrated analysis of the way through the EMG system, which is to assess the reproducibility of transcranial electric stimulation (transcranial electric stimulation, rTMS) for stroke patients with upper limb motor function. Whether it has efficacy, and to further explore the relationship between the stimulation pattern and effect. This paper proposes a method for analysing a stroke patient after by brain stimulation can activate the entire brain hurt. Investigation incompetent driving finger stalls, then the application of science and technology to create an artificial arms with MEMS accelerometers and motion control equipment.

I. INTRODUCTION

Stroke is an important cause of disability in the current worldwide. Movement impairment is the most important legacy of stroke patients [1-3]. Especially in upper limb motor function is the most serious defect. Traditional and contemporary rehabilitation training methods are to make patients recover part of upper limb function [4-6]. But it is still not ideal. Emerging therapies have been developed and are trying. Electrical stimulation of the brain (brain stimulation) is a ring of more recent studies. Which transcranial magnetic stimulation (transcranial magnetic stimulation, TMS) is a non-invasive intervention methods.

EMG biofeedback signal is composed of one or more motor unit action potentials generated by the show. The so-called motor unit is composed of anterior horn cell;AHC), the axon, and all the muscle fibers dominated the anterior horn cells together to form a functional unit. Activation of a motion unit is in line with full-nothing laws. It produces motor unit action potentials (motor unit action potential; MUAP). Surface electrode sheet can be used to collect or needle shock. These action potentials and ECG was similar record. Each motor unit action potentials of all muscle fibers is in the motor unit discharge governed sum. EMG biofeedback system is not particularly original presentation of each motor unit EMG signals, but in a simplified format (also known as EMG integral way) rendering. Points EMG muscle activity monitored presentation, this signal is proportional to the degree of muscle contraction. In other words, the more the recruitment of motor unit's integral EMG signals are greater.

The motion of the fingers and hand contain the accelerometers on the finger, and the back of a hand. Having the signal caused by the moving of hand from the MEMS accelerometers, Micro controller unit receives the signal, and controlled the corresponding outputs. The identified conditions of input signal and the corresponding output signal are written in the micro controller in advance. In order to precisely determine the moving, the key features are that using the both of the dynamic and static state identifies the input signal, and avoid the repeating of input. The experimental results show that the proposed method successfully identified the motion of the hand, and had the right output signal, and even successfully controlled the cell phone to take picture with fingers gear.

II. ELECTRICAL STIMULATION APPLICATIONS IN FUNCTIONAL ACTIVITIESASSUMPTIONS

The clinical use of functional electrical stimulation include: Treatment of disuse atrophy, heart rate variability, muscle reeducation and induce action, treatment of scoliosis, maintain joint mobility, alternative stents, reduce spasms.

Treatment of disuse atrophy should teach and inform the patient with electrical stimulation to do autonomous contraction as shown in Fig.1. Functional electrical stimulation is in clinical applications. It is useful for the treatment or surgery due to stroke and other causes of long-term immobile patients, and bedridden patients. These patients can be improved muscle atrophy. If not yet atrophy, people can try to avoid the phenomenon of muscle atrophy.

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Figure 1: Functional electrical stimulation of the brain.

2.1. sEMG and MEMS accelerometer device

All kinds of home appliances gradually have come to our life since the last century. Including artificial the back of the hand evolve from robots[7-9], hand kinematics, the branch of mechanics concerned with the motion of objects without reference to the forces that cause the motion, from brain signal research[10-12], EMG signals identification using neural network development[13-15], MEMS accelerometer system of a robotic the back of the hand technology [16-17], gesture recognition [18], sensor microsystems integration, However, as electronic product diversification and Bluetooth remote control has become a trend, making the most of the electronic products are control systems. sEMG and MEMS accelerometer device apply to artificial arms. Prosthetic friend is inconvenient to use remote control. And Prosthetic friends have to spend more time to find the correspondent remote controls, and it would cause the waste of time and energy and even the inconvenience to users. In addition to, the range of remote control is limited to the plane. Included fingers gear motion judgement, and mode switching control system, if we don't use it on the plane, a lot of functions will not operate anymore. We improve the above problems, it will have a big impact on the future of humanity.

This research describes the work aimed to investigate the brain stimulation and control devices for driving incompetent fingers gear and then science technology application. It is a description from a stroke patient after by brain stimulation can activate the entire brain hurt. Investigation incompetent driving finger stalls, then the application of science and technology to create an artificial arms with MEMS accelerometers and motion control equipment.

2.2. Control devices

The investigated includes a microprocessor, three MEMS accelerometers, and the 3V power supply. Each element is being introduced as below: MSP430 MCU (Microcontroller Unit). The MCU used in the experiment receive signals generated by hand movements, and then transfer instruction to the hardware devices (mouse, selfie stick are used in this topic). MSP430 is based on the 16-bit RISC mixed-signal processors, which features low power consumption.

The flowchart in the software of the main architecture of the overall system is shown in Fig. 2. Every accelerometer is read by another subroutine. As for the control below the accelerometer is operated by the accelerometer subroutine which can decide the counter value.

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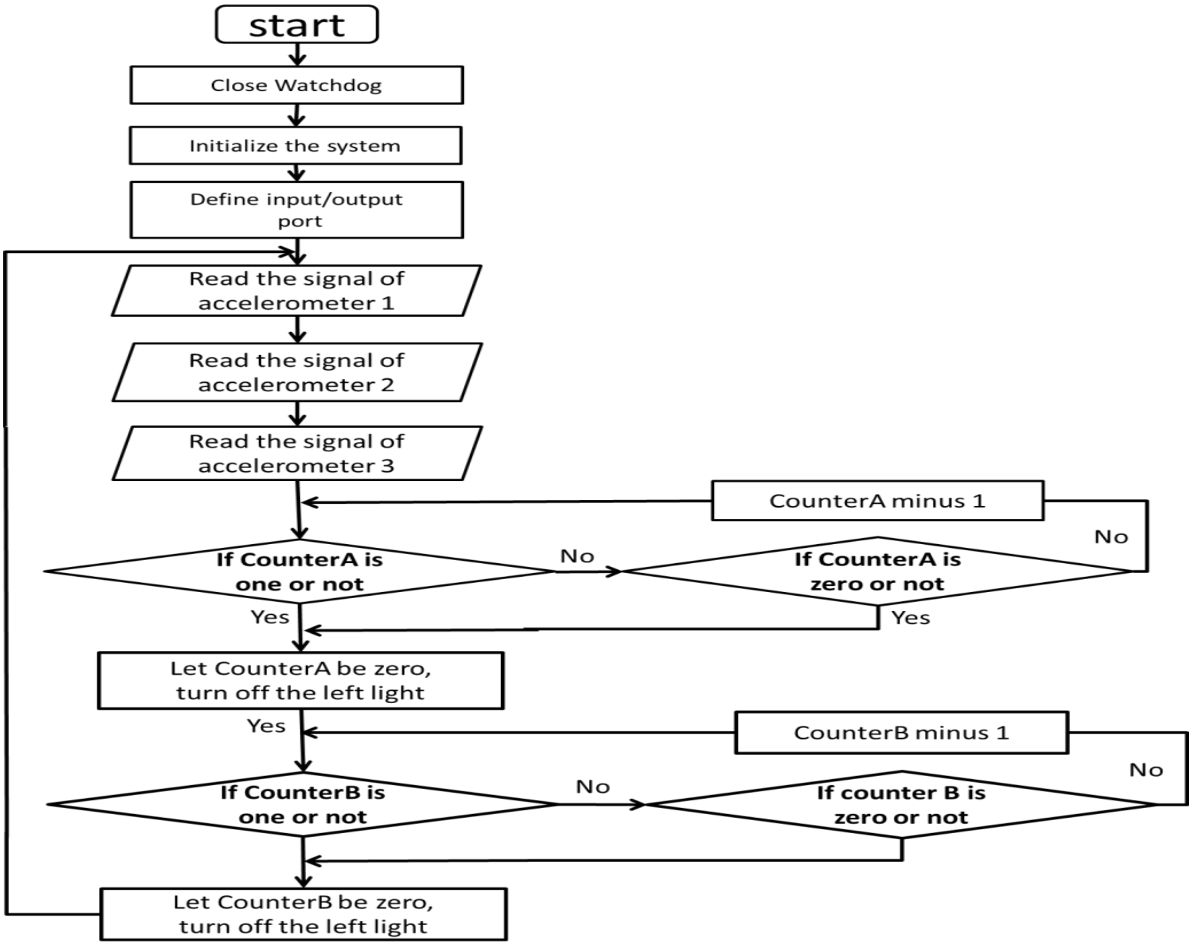

Figure 2: The flow chart of the main program.

III. EXPERIMENT AND RESULTS

Heart rate variability, muscle strength and malnutrition-inflammation complex syndrome are associated with increased risks of mortality in stroke patients, general population respectively. We aim to quantify the severity of heart rate variability, muscle strength and malnutrition-inflammation complex syndrome for risk stratification in stroke group. Non-invasive electrocardiography and electromyography electrode system are utilized to measure heart rate variability and muscle strength. Biometrics electric signals were recorded for real-time monitoring during stroke and analyzing the individual's unique physical health condition as shown in Figure 3.

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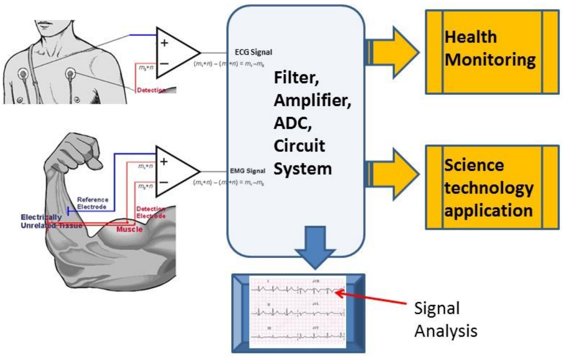
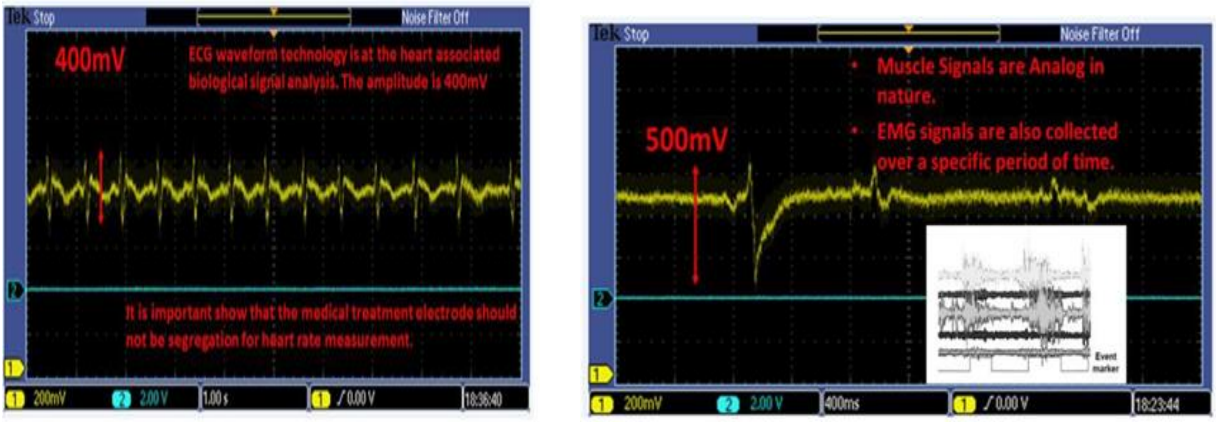


Figure 3: The Electrocardiogram (ECG) and electro myogram (EMG) signal capture system.



Electrocardiogram (ECG) Signal Electromyogram (EMG) Signal

Figure 4: The stroke patient's physical health signal detection results.

CR We aggregated for stroke patients physical health signal detection results(Fig. 4.):

•Noninvasive ECG and EMG system patches contain sensing and demonstration captured signal filters, amplifiers, ADC circuitry. It is an exact record physiological signals of stroke patients.

•It is precisely record the ECG heart rate variability signal using a special stroke patients was analyzed.

•It is the exact record EMG muscle stroke patients is analyzed. Reliable Methods of biological sensing electrode in the form of combination of biological science and technology system to provide micro-electronic products.

•Typical repetition rate of muscle unit firing is about 7-20 Hz.

•Damage to motor units can be expected at ranges between 450 and 780 mV

3.1. EMG electrode system

If the shoulder dislocation, it applies after the stroke. In this case the spine caused by electrical stimulation and deltoid muscle (supraspinatus and posterior deltoid) contraction as shown in Fig. 5. Pedal issue of treatment of stroke patients. It is most appropriate to the stimulating electrode placed tibial is anterior muscle (anterior tibial is).

Induced muscle re-education and motion control. For patients with damaged nervous system, Electrical stimulation can give a lot of sensory stimulation. There are great benefits to induce or re-education of active control capability. The ability is not only re-building the patient autonomous control but also be motion control.

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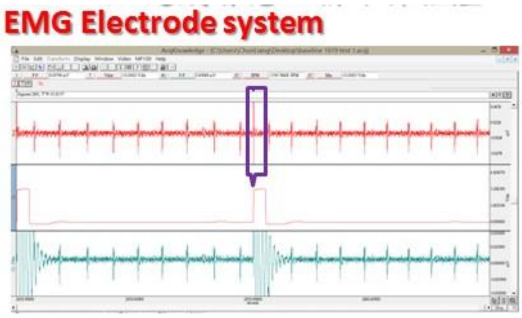

Figure 5: EMG biofeedback system.

Therapy parameters: people can select the waveform of gradually formula. Frequency of 20-30 Hz, the treatment cycle : on : off =1 : 2-5. Dispersion electrode can be placed in the proximal end of the body. The active electrode is placed in motion point (motor point).

3.2. ECG records electrical activity

The use of ECG records electrical activity of cardiac contraction generated. Arrhythmia refers to abnormal or irregular heart sinus rhythm. Whether it is the heart's electrical conduction dysfunction or abnormal heart itself. It is called arrhythmia. Early diagnosis is very important for arrhythmias

Method : Using the patch sensing heart rate signal. Heart cells are generally still the case that belongs charged (negatively charged), or called "polarized“. Once they receive electrical stimulation, "deporlarized", positively and generate contractile response. Although cardiac functioning independently by the sinus node, it is possible to borrow those sympathetic (to stimulate contractions) and parasympathetic (calming) various brain signals pass through the secondary heart and body parts to adjust the rate of heart beat. It is to accelerate or reduce the speed of blood circulation to the outside world should occur due to a variety of situations.

Range : 60Hz-100Hz for normal waveform and rhythm.

Figure 6: 60Hz-100Hz for normal waveform and rhythm.

Different pitch of period is showed arrhythmia as shown in Fig.6. It is about 60Hz record heart rate signals for “A”, and about 65Hz for “B”. Over time, cause permanent damage to their heart, so that the higher the probability function is impaired. If the arrhythmia is abnormal and clinically significant, the doctor will set a treatment plan.

3.3. The judgement of the hand inclination

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After constructing the basic prototype, as shown in Fig. 7, we have written the hand motion which we want to analysis into MCU by the software. The motion includes the forefinger and middle finger click action, the judgement of the hand inclination, and the forefinger and middle finger click action when hand is inclined. We have finish the connective device, we use the LED display to show the finger gesture by the corresponding LED dots. There are 11 LEDs on the plate, the cross-like arrangement is used to determine the hand inclination, and the other two are determine the judgement of the click of the index finger and middle finger respectively. When the palms tilts, we can observe it from the change of the lighting sequence. After the package, we carried out the third stage. We put the device on the glove. We want to understand the influence caused by the package. The three experiments were done. First experiment is that putting the device on the glove is convenient or not. The second is manipulation of the LED display and extend to the selfie stick finally. The test action includes the click action of the driving index finger and middle finger, the judgement of hand inclination, and the click action at the same time of the driving index finger and middle finger. The third is that using the click operation to trigger the instruction of the cell phone camera. We have succeeded in taking pictures of finger gear, stroke patients after stimulation head activation as shown in Figure 8.

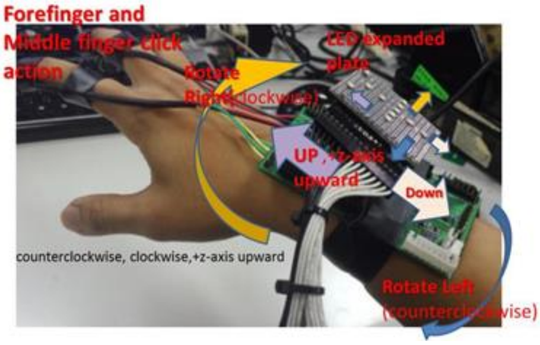

Figure 7: Prototype of the device.

Figure 8: Take the picture through our fingers gear.

In the first phase, the three-axis MEMS software system "iNEMO" measured accelerometer signal far from our expectation. The first point is that when a person tries to variation only one axis of acceleration, said retaining two-axis inclined at the same time change, when the accelerometer to change the a axis, while the interlocking another axis also changes with the person; and the second point is that the voltage signal measurement process easily saturated. As the signal characteristics in Fig. 9 clearly enough when one attempts to measure the change in rotational motion acceleration. As Fig. 10, once we make the distinction between the z-axis of the original signal, it is smart for us to determine it either clockwise or counter clockwise rotation. Furthermore, the sensor is able to track a long called gestures. We have been developing and research, with their attitude in the next rotation.

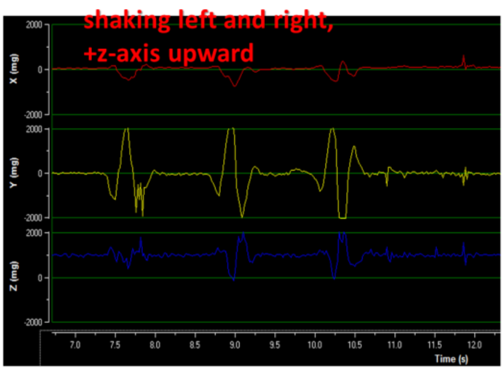

Figure 9: iNEMO test signal (shaking left and right, +z-axis upward).

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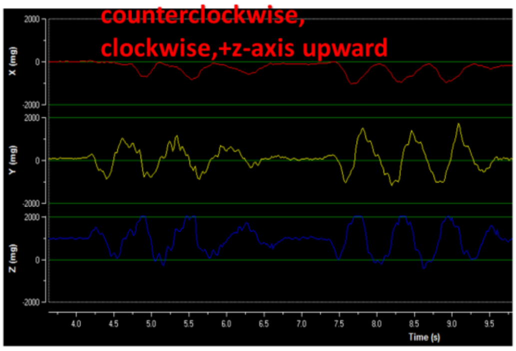

Figure 10: iNEMO test signal(counterclockwise, clockwise,+z-axis upward).

IV. CONCLUSION

We have developed and investigated to analysis of the way through the EMG system, which is to assess the reproducibility of transcranial electric stimulation (transcranial electric stimulation, rTMS) for stroke patients with upper limb motor function. Analyzing a stroke patient after by brain stimulation can activate the entire brain hurt. We have developed and investigated to analysis stroke patients hand gestures through three MEMS accelerometers, and with different gestures, there is the corresponding command. Gesture included helicoid rotation of arm, individual click of first finger and middle finger, spontaneously rapid click of both fingers and some arm displacement.

V.ACKNOWLEDGMENT

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