ADAPTIVE EMG-DRIVEN COMMUNICATION FOR THE DISABILITY

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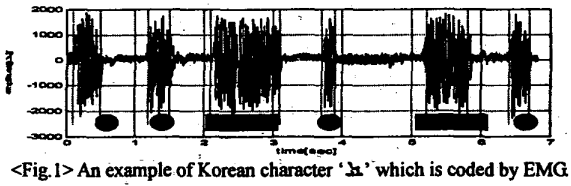
Abstract – In this paper, we suggested a communication method between severely disabled, who lost both mobility and speech, and their family using Morse code derived by Masseter muscle EMG. We developed a portable system that comprises EMG amplifier, A/D conversion, text-to-speech module, remote control module and serial communication to the host system. After training, the patient can make a speech by composing Morse code with moving his/her chin. Calibration and remote controlling mode is supported. It also supports the adaptive encoding method for the fatigue.
Keywords – Morse-code, EMG, disabled, communication

I. INTRODUCTION

The most severely disabled who are not only suffering from the lack of mobility but also have no ability to speak have lost the ability to communicate. Several methods are developed for the communication of severely disabled, such as targeting by head movement, gaze-controlled system, and etc. But these systems need high cost and complex instrument [1][2]. As an efficient auxiliary method, we focused on the portable and inexpensive method of a single-switch communication with the Morse code. There are several articles on the Morse code based communication for the disability [2][3]. In almost all cases, they used the finger switching method, so it cannot be applicable to some severe patients who lost mobility.
After investigation, chewing with the Masseter muscle can be the reasonable choice for switching. In this paper we present the EMG based Morse coded communication method.

II. MATERIALS and METHODS

1.Converting EMG signal to Morse Code
We developed a portable EMG amplifier with the gain of 10^5 and high input impedance (10^{12} Ohm) using instrumentation amplifier INA118 (Burr-Brown). The main controller for the acquisition and processing of EMG signal is PIC16C74. The EMG signal is digitized at 500Hz through an internal 8-bit A/D converter. The EMG signal is transferred to the host PC through RS-232. By thresholding the EMG variance, the dot and line of the Morse code is encoded.

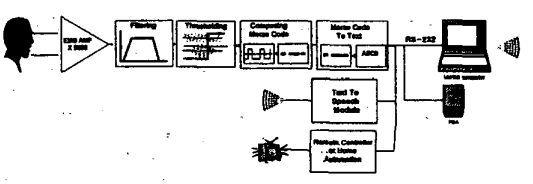


<Fig.1> An example of Korean character 'ㅎ' which is coded by EMG

When EMG is fired, it is regarded as a dot or line according to the burst duration. The duration of EMG burst and interval between EMG bursts are used for encoding Morse code. <Fig.1> is an example of Korean character 'ㅎ'. We defined additional codes for controlling the communication.
We applied adaptive encoding, because toggling the switch is not constant for the disabled, and fatigue makes the burst threshold, interval and duration variable [3]. Adaptive algorithm we used is LMS.

2. Morse Code to Speech and Control
For the portable use, the Morse coded signal is translated to ASCII character. ASCII words are transferred to the word processor and to TTS module, which synthesizes speech from the text. In this way, the disabled can speak through the speech synthesis system. It can also help the disabled to control the home automation system, such as watching TV, listening music through remote controller operated by Morse code.

3. Training and Calibration
For the patient, adaptation to this system to the degree of muscle movement and duration is essential. We developed a program for training the patient. The raw data signal is displayed to the screen and the encoded Morse code and characters and synthesized speech are presented together. The whole system is shown in <Fig.2>



<Fig.2>The system diagram of Morse coded communication to speech and controlling

III. RESULTS

In this paper, we suggested the EMG based Morse-coded communication for ALS. It can support the disability to speak and control the home electronic systems with a portable and low cost device.
The major limitation is that the time to make a word, because the disabled cannot chew-and-pause fast. But to the disability that cannot communicate at all, it is very helpful to be free from the great internal monologue.

REFERENCES

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