A Cursor Control Based Chinese-English Brain-Computer Interface Speller
Conghui Chen, Jing Yang and Bin Xia*

Abstract— In this work, we developed a Chinese-English brain-computer interface speller based on 2-D cursor control. We built the English speller by integrated a motor imagery based 2-D cursor control strategy with a three-layer interface and combined the Pinyin input method with English speller to input Chinese characters. The online experimental results demonstrated that three subjects achieved good performance.

I. INTRODUCTION

Most of BCI spellers are designed for English, which are not suitable to input Chinese because Chinese characters are not alphabetic writing. Pinyin input method, which uses English characters to represent the pronunciation of Chinese characters, is often used to input Chinese characters. To combine Chinese and English input in the same interface, we developed a Chinese-English BCI speller based on 2-D cursor control, which input English characters in ‘Oct-o-spell’ paradigm and spelled Chinese characters using Pinyin input method.

II. METHOD

In our previous study[1], we developed a motor imagery (MI) based 2-D control system in which the subject can move cursor to any position of 2-D plane using three-class motor imagery. In this paper, we presented a three-layer of ‘Oct-o-spell’ paradigm shown in Fig.1.

In the first layer, 26 letters, 10 figures and 5 symbols (‘Quit’, equal, Enter, comma, ‘F1’, and full stop) were divided into eight blocks. In the second layer, 7 different interfaces were designed to unfold the blocks in the first layer. Only two symbols in the second layer connected to the third layers. One was ‘F1’, connected to a third layer with 6 punctuations: ’*’, '@', '？', '+', '!', '#'. The other one was ‘Quit’, connected to a third layer with ‘YES’ and ‘NO’ blocks, was used to quit the speller system. To spell a character or to output a command, the subject should move the cursor to choose the target block in two or three steps.

The default status was English input state. The subject can switch to Chinese input state by choosing switch block in the first layer. To input Chinese words ‘你好’ (How are you?), the subject should input the Pinyin-‘nihao’, then the input method software will translate them to the Chinese words.

Three subjects were invited to participate in online spell experiments: 1. English copy experiment; 2. Chinese copy experiment; 3. Chatting experiment. In the first two experiments, three subjects were asked to spell the given 15 English words and 10 Chinese words. In the chatting experiment, the subjects were asked to answer 6 questions, alternating in Chinese and English, using the chatting system consisted of the bilingual speller and Tencent QQ (instant message software).

III. RESULT AND DISCUSSION

We evaluate the performance using the accuracy, letter per minute (LPM), information transfer rate (ITR)[2], second per letter (SPL). The results are showed in Table 1.

<table>
<thead>
<tr>
<th>Table Head</th>
<th>Accuracy (%)</th>
<th>LPM</th>
<th>ITR</th>
<th>SPL</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>95.18</td>
<td>10.16</td>
<td>62.39</td>
<td>8.05</td>
</tr>
<tr>
<td>Chinese</td>
<td>95.54</td>
<td>6.01</td>
<td>49.73</td>
<td>11.69</td>
</tr>
<tr>
<td>Chatting</td>
<td>99.17</td>
<td>5.53</td>
<td>30.86</td>
<td>10.88</td>
</tr>
</tbody>
</table>

The accuracy for English copy experiment is 95.18% and the ITR is 62.39bit/s. The accuracy and SPL for Chinese copy experiment is 96.04% and 11.69s which is better than the result of 59.4% accuracy and 77s SPL in [3].

REFERENCES


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