研究課題名（英文）

Development of a reminder system with multisensory stimulation to support the daily living of elderly individuals with cognitive impairment

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全体要旨（英文）

This study aimed to develop a reminder system using multisensory (visual, somatosensory, and auditory) stimulation to assist individuals with unilateral spatial neglect (USN) or dementia to operate an ambulatory support device, especially a wheelchair, as both conditions adversely affect activities of daily living, and ambulation in particular.

For individuals with USN, the HMD system was utilized to provide additional visual information. The system has reminder modes of arrows, shrinkage, and edge enhancement to alert them. For individuals with dementia, the system also uses a light emitting diode (LED) to assist their wheelchair operation. Reminders can also be provided in the form of textual information through the HMD or a small television. Voice is used as auditory stimulation to direct wheelchair operation, such as braking. Moreover, somatosensory stimulation in the form of vibration is used to warn the seated wheelchair operator about a potential risk of overturning if the system detects a large shift in the center of gravity to the front, back, left, or right.

The new system has two specific functions: (a) directing correct operation of an automatic wheelchair and (b) warning the operator about incorrect operation and potential overturning. The current prototype is equipped with sensors (for the detection of mechanical motion) mounted on the right (1) and left (2) brakes and the right (3) and left (4) footrests to monitor operation of the ambulatory device, and another sensor on the seat (5) to detect standing motion. In addition, the brakes and footrests are mounted with an LED to provide a visual reminder of the next step, to prevent incorrect operation. For individuals with dementia who have difficulty recognizing the situation from visual cues only, a speaker with an audio visual display function has been mounted to enhance the warning capability of the system. We have also developed a system with a transparent HMD to provide supplement visual information when performing a dynamic movement (gait, wheelchair operation, etc.). The main computer accurately sends out light signals, displays on the HMD device, and presents audio messages as a reminder to use the brakes and footrests. When the wheelchair operator is using the brakes and footrests in the correct manner, the system simply prompts the next step. The system also has a function that emits light flashes and voice messages for risk avoidance when the operator mistakenly uses the brakes or stands up with the footrests still lowered. A vibratory stimulation warning system was also built in so the operator is warned if the risk increases of tipping over.

The study was to analyze the effectiveness of new reminder system for patients with clinical symptoms of unilateral spatial neglect or dementia. Wheelchair operation was videotaped to analyze their movements and postural changes. A data logger with an on/off switch was also used to record various wheelchair operations (braking, using the footrests, and postural changes from sitting to standing position) to compare the

influence of light, audio, HMD, and vibratory signals on the correction of incorrect wheelchair operations. In addition to the light, audio, and HMD (text and voice) signals, a vibrating seatbelt was investigated to determine its contribution as a warning system in stopping a wrong motion at the time of incorrect braking and initiating a correct one. The results indicated that visual or audio stimuli could reduce the number of operation errors. We plan to develop a reminder system that can be tailored to the needs of individuals with a variety of difficulties operating a wheelchair.