

Spider Eye (FLIPPS)

Introduction

The Spider Eye is an extension to the traditional cane that is used by the visual impaired people. It helps visual impaired people to distinguish between light and dark environments, recognize white from black objects and even more distinguish between two objects with different illuminations.

The Spider Eye idea is based on sensory substitution theory (in my device substituting visual inputs by haptic vibrations). By repeated training session the visual impaired person will be able to construct a mental image of her/his environment.

This product is the subject of my Master thesis that I'm still working on; the idea was inspired from a French group that is working on brain plasticity for visual impaired people.

Prototype description

The hardware of the prototype I made is shown in Figure 1; it consists of:

- 1- A glove equipped with four photodiode sensors; three on the top of the fingers and the fourth on the middle of the hand (Figure 1 (a)).
- 2- Beneath each of the three fingers a vibrator is attached to the finger tip (I used the vibrator from a normal headphone).
- 3- The black box includes; a microcontroller, a programmable gain amplifier and a 9V battery
- 4- A black tube is attached to the top of each of the first three sensors in order to make there scanning more directional.
- 5- Furthermore the black box is equipped with a turn on/off button and a pair of belt hooks (Figure 1 (b)).

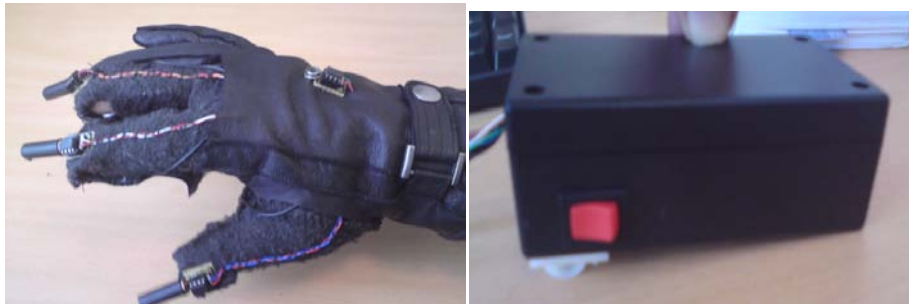


Figure 1: (left) The glove equipped with the four photodiode sensors and the vibrators. (right) The black box equipped with the on/off red button and the belt hooks.

The basic idea of the Spider Eye is that when the user points to a light object, the corresponding vibrator will be activated. The three fingers work independently and therefore we can easily increase/decrease the number of fingers to use.

Future work and perspectives

As far as I know this prototype is the first of the kind; and I believe that there is a lot of space for improving the device. For that reason I'm considering to take my PhD. on the same topic, so I'll have both the time and the money to apply my ideas and improvements.

Test protocol

The first goal of this test protocol is to introduce the device to the test subjects and train them to use the device. The second goal is to test whether the device can be used to see/recognize simple objects.

The test is performed in a dark room, where the test subject is blindfolded and seated comfortably in front of a 19" display screen. On the display screen a white object is showed; the screen contrast, brightness and the size of the object are fixed. The subject will be asked to wear the device and try to recognize the objects on the display screen; the distance between the device black tubes and the display screen was about 20 cm. The time and hit rate is measured after each trail.

The test will be divided into three phases/levels according to the complexity of the object. The first two phases are training sessions; the goal of them is to get the test subject familiar with using the device. At the training sessions the test subject will be guided and instructed to how to use the device.

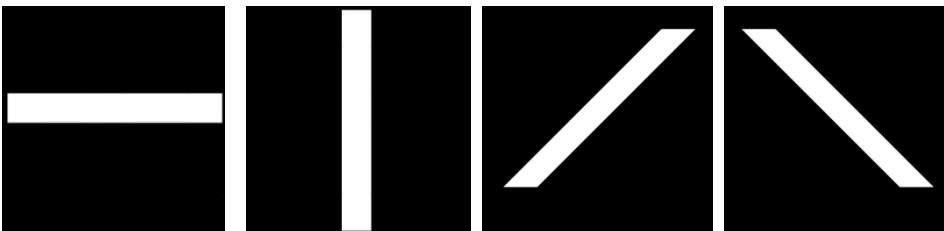
At the third phase the objects will be two-line objects and the subject will not be guided by the trainer. Thirty trails are presented at this phase where the object size and the illumination are standardized. The subject will have max 30 seconds to recognize the object; otherwise the test subject is asked to give a guessed answer. Furthermore the subject will be asked to give a grad [1-4] for how certain her/his answer is (1= a guessed answer; 4 = a certain answer).

The objects that are used in the three phases are shown below:

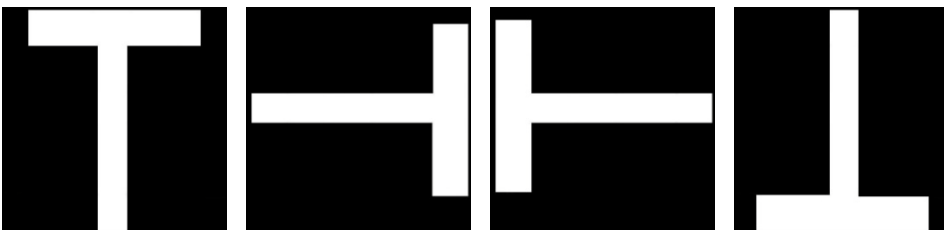
Phase One



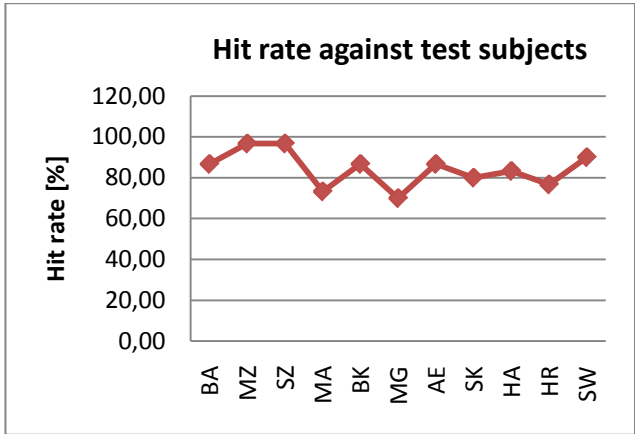
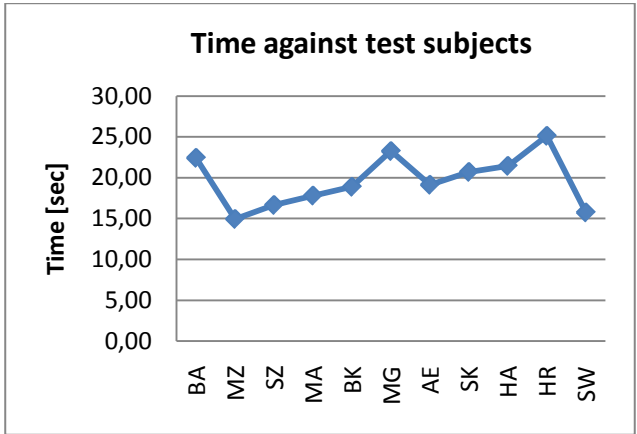
Phase Two



Phase Three



Ten blind folded test subjects have been tested; the hit rate results is shown in the figure below. The test showed a relative high hit rates (70-97%); furthermore the average time per trial was between (15-25 seconds).



Furthermore there are two other test protocols; the first one involves audio, visio and audio-visual suboptimal stimulation and the main objective was to investigate where there is an improvement in the hit rate for the audio-visual stimulation.

The last test is the brain plasticity test, where the test subjects are tested for five subsequent days. The objects that were used were: (F, H, L, T, Z, N). The results so far showed a significant improvement of the hit rate across the five days training.

For more details regarding these experiments, you are very welcome to contact me.