Thermal Matrix for the Blind

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The paper deals with the prototype of the Thermal Characters Matrix for the blind. The prosthesis is built up with the use of many miniature Peltier modules deposited on the common substrate. The surface of each Peltier micropump is a touch point, which demands the thermal stabilization. Miniature Peltier modules behave both as heat and cold generators. They are also able to measure the required dot temperature. The control system keeps the constant temperature, no matter how the ambient conditions look like. The tests with the blind have been carried out. The results are very promising.

A pending patent with the use of Thermo Electric Coolers (TEC, Peltier micropump) gives possibility not only to generate thermal power, but also to transfer heat from one side to another.
With our idea it is possible to heat or cool Braille dots, so device can reach the required temperature faster comparing to previous solution based on resistors or LED's [1]. Moreover, to reach necessary temperature the device consumes very limited electrical energy. A part of energy is stored into heatsink, which performs as a heat capacitor.
In order to accelerate the work of the thermal signs, the current supplied to the heat micropump ought to be high, and when the difference of temperature achieves required value – the supply shall be disconnected.
Figure 1. presents acceleration of work of thermal signs with temperature control system.

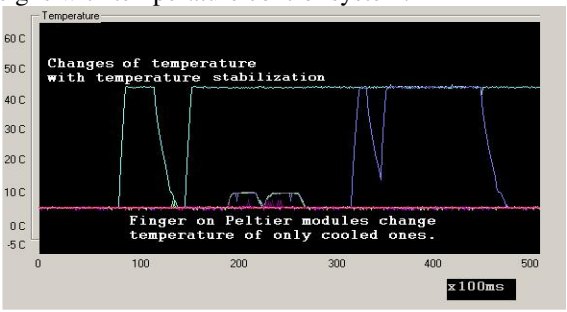

Figure 1. Measured changes of difference of temperature on TEC.

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The time constant of Thermo Electric Coolers used in the prototype is about 2.2 seconds [3]. Nevertheless, period of time that the Peltier micropomp needs to achieve the target temperature was shortened to 0.2 seconds by a special temperature control system.
Applying finger to the thermal signs changes only the temperature of the cooled ones. Temperature of the heated ones stays steady. The photo of the fully set device is shown on Figure 2.

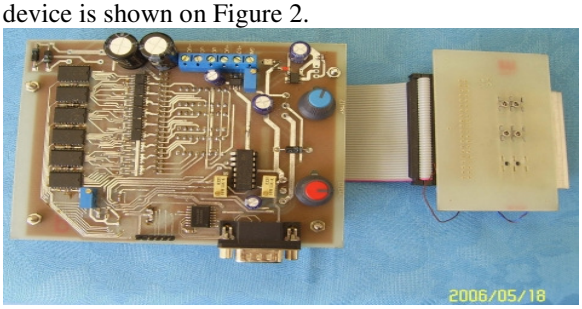

Figure 2. Second prototype of the thermal matrix

By using the thermographic MK525 camera, a few photos have been made. Dark places mean temperatures about 10°C, bright about 40°C.

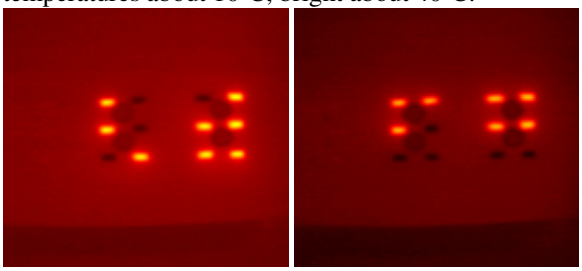

Figure 3. Thermograph photos of the thermal matrix for the blind

According to the blind people, warm dots are subjectively easier to recognise than the cold ones. After the first hour of training in reading the blind woman was able to recognize more than 90% of displayed Braille signs and it took her a few seconds.
The power consumption is so small that it makes it possible for the matrix to be a mobile one. The regulation of touch point temperature makes the recognizing easier and more comfortable.

Presented experiments have shown that the use of the Peltier micropump with thermal stabilization enables building of faster and more efficient thermal matrix for the blind people. The touch surface of each Peltier micropump demands the thermal stabilization. The use of the TEC for the thermometry makes it possible to use the active element as the sensor.

[1] De Baetselier E., De Mey G., Kos A.: "Thermal image generator as a vision prosthesis for the blind", MST News, Poland, 3/1997, pp. 3-5
[2] Thermoelectric Cooling Module type 1MT03-008-13 Specifications. *RMT Ltd.* 2005.