Motor Skill Enhancing Pen

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Abstract
The idea underlying our project is to use positive reinforcement techniques for assisting with efficiently grasping writing utensils. It is intuitive that poor pen grip may lead to poor handwriting. In addition, by exercising inefficient grip, we put extra strain to our hand joints. The latter causes pain and turns young children or children with disabilities away from writing. Training kids for proper pen holding may be quite challenging and our design may help with this challenge. It requires a pen device to be connected to a microcontroller, such as the Arduino platform, and responds by displaying a message indicating whether the pen is held correctly or not. Apart from a microcontroller, our project also uses resistors and photo resistors, making it relatively inexpensive to develop.

Introduction
In 1990, when Peter Salovey and John Mayer presented their pioneer work on emotional intelligence, a "new way of thinking about the ingredients of life success" challenged the preeminence of IQ (1), (2). Document (3) summarizes the emotional intelligence components as stated by Daniel Goleman. 1. Self-awareness: able to look into our emotional world 2. Self-management: able to rein in our emotions 3. Social Awareness: able to empathize with people with different cultural backgrounds 4. Social skills: able to lead, persuade and negotiate.

Teaching a young child or a child with disabilities how to grasp a pen efficiently may be frustrating for parents and teachers as well as the child. It may lead to negative comments and even to diatribes, which are counterproductive to the learning process. Positive reinforcement techniques stand to make the learning process more productive and cultivate the competencies of self-awareness and self-management. At the same time positive reinforcement may allow the students to study at their own pace without being constantly stressed about satisfying the parent or the teacher.

In this paper we will describe a prototype that encourages the students to hold a pen efficiently by playing sounds and displaying visuals.

Electric circuit model

This section will describe the electric circuit that models our prototype and is depicted in Figure 1.

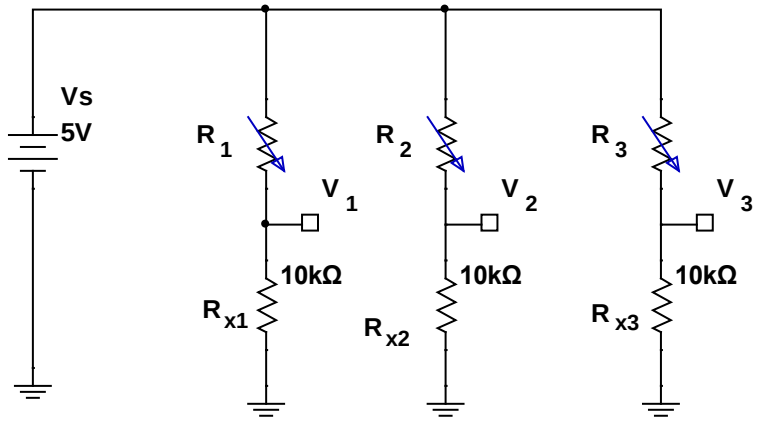

Figure 1. Electric circuit model

The power source V_s is 5 Volts. R_1, R_2, and R_3 model photo resistors, whose value changes with the intensity of the incident light. As Eq. 1 shows, the resistors R_1, R_2, and R_3 dictate the values of the voltages V_1, V_2, and V_3, which in turn dictate whether the pen is held appropriately or not. R_{x1}, R_{x2}, and R_{x3} are constant resistors whose value was empirically chosen to be 10 kΩ.

$$\boldsymbol{V_1 = \frac{R_{x1}}{R_1+R_{x1}} V_s}, \quad \boldsymbol{V_2 = \frac{R_{x2}}{R_2+R_{x2}} V_s}, \quad \boldsymbol{V_3 = \frac{R_{x3}}{R_3+R_{x3}} V_s} \qquad \textbf{(Eq. 1)}$$

Figure 1 does not include the reinforcement mechanism. As Figure 2 shows, the voltages V_1, V_2, and V_3 are inputs to a control device that outputs a control signal triggering the reinforcement mechanism.

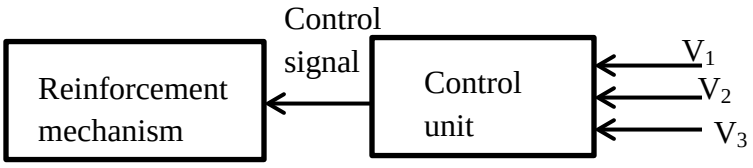

Figure 2. Reinforcement mechanism

Figure 3 depicts the implementation of the electric circuit model on a protoboard, where the reinforcement mechanism is provided by a buzzer. The implementation uses Arduino Uno in the place of the microcontroller shown in Figure 2.

In reference to Figure 3, the one terminal of the photo-resistors R_1, R_2, and R_3 is connected with the 5V pin of the Arduino board. The other terminal of R_1, R_2, and R_3 is connected with the resistors R_{x1}, $R_{x2,}$ and R_{x3}, respectively. The other terminal of R_{x1}, $R_{x2,}$ and R_{x3} is connected with

the GND pin of the Arduino board. The pins A_0, A_1, and A_2 of the Arduino board receive samples of the voltages V_1, V_2, and V_3, respectively. The pin A_{13} of the Arduino board is connected with the buzzer, whilst the other terminal of the buzzer is connected with the ground of the circuit.

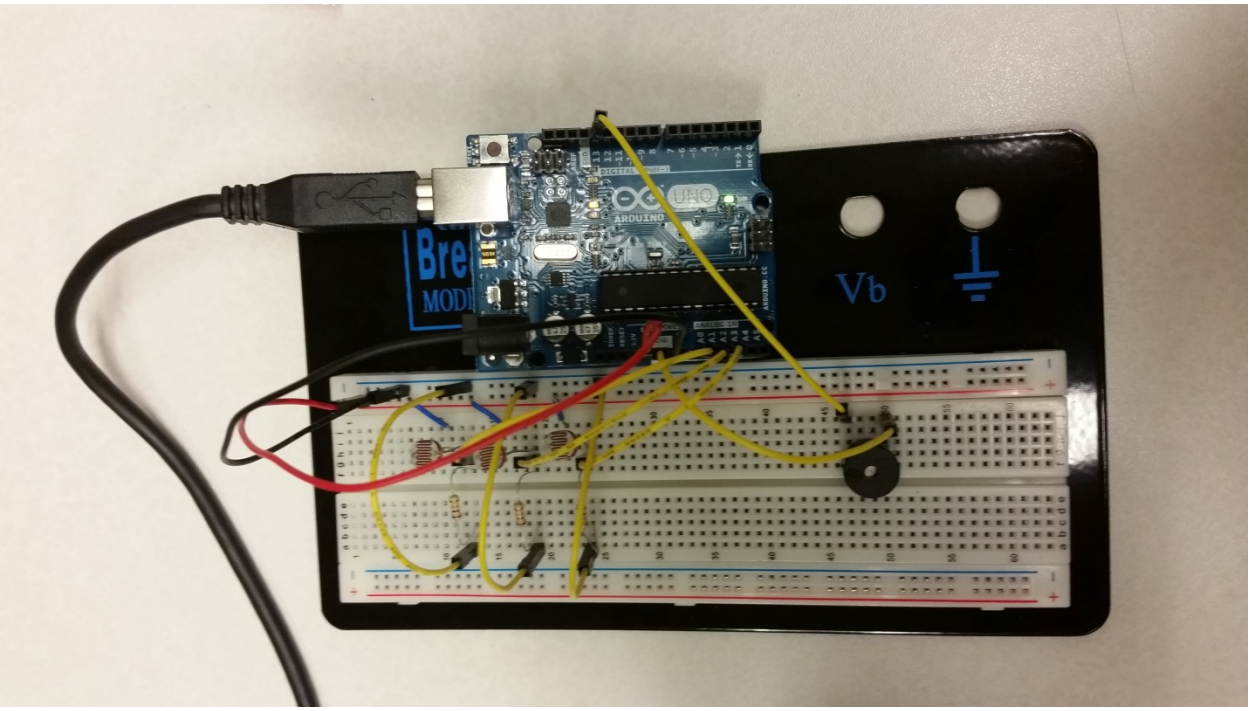

Figure 3. Protoboard implementation

Physical model

This section will describe the physical model of our design, which is depicted in Figure 4. The electric circuit of Figure 1 is folded into the body of a Zebra Z Grip pen. Depending on how the user holds the pen, an appropriate message will appear on the computer monitor. The message may be positive and encourage the users to maintain their grip. The message may also be negative and increase the users' awareness about their bad habits. The pen communicates to the Arduino platform via an Ethernet cable. An RJ-45 shield lies over the top of the Arduino platform and extends its capabilities. Inside the pen, the individual wires of the Ethernet cable are connected with the power source V_s, the resistors R_{x1}, R_{x2}, and R_{x3} and the ground of the circuit. The individual wires of the Ethernet cable are soldered on the shield so that connections are established between the Arduino and the electric circuit residing inside the pen.

Conclusions & Future Work

This paper described our prototype that uses positive reinforcement techniques for assisting with efficiently grasping writing utensils. To our best knowledge there is no similar work in the marketplace. Our design requires a microcontroller, in place of which an Arduino platform is

used. Currently only Arduino software is used and the reinforcement mechanisms consists of messages displayed on the computer monitor. In the future, we will look into adopting a different processing environment for improving the reinforcement mechanism with the addition of sound and the display of messages offering constructive critism.

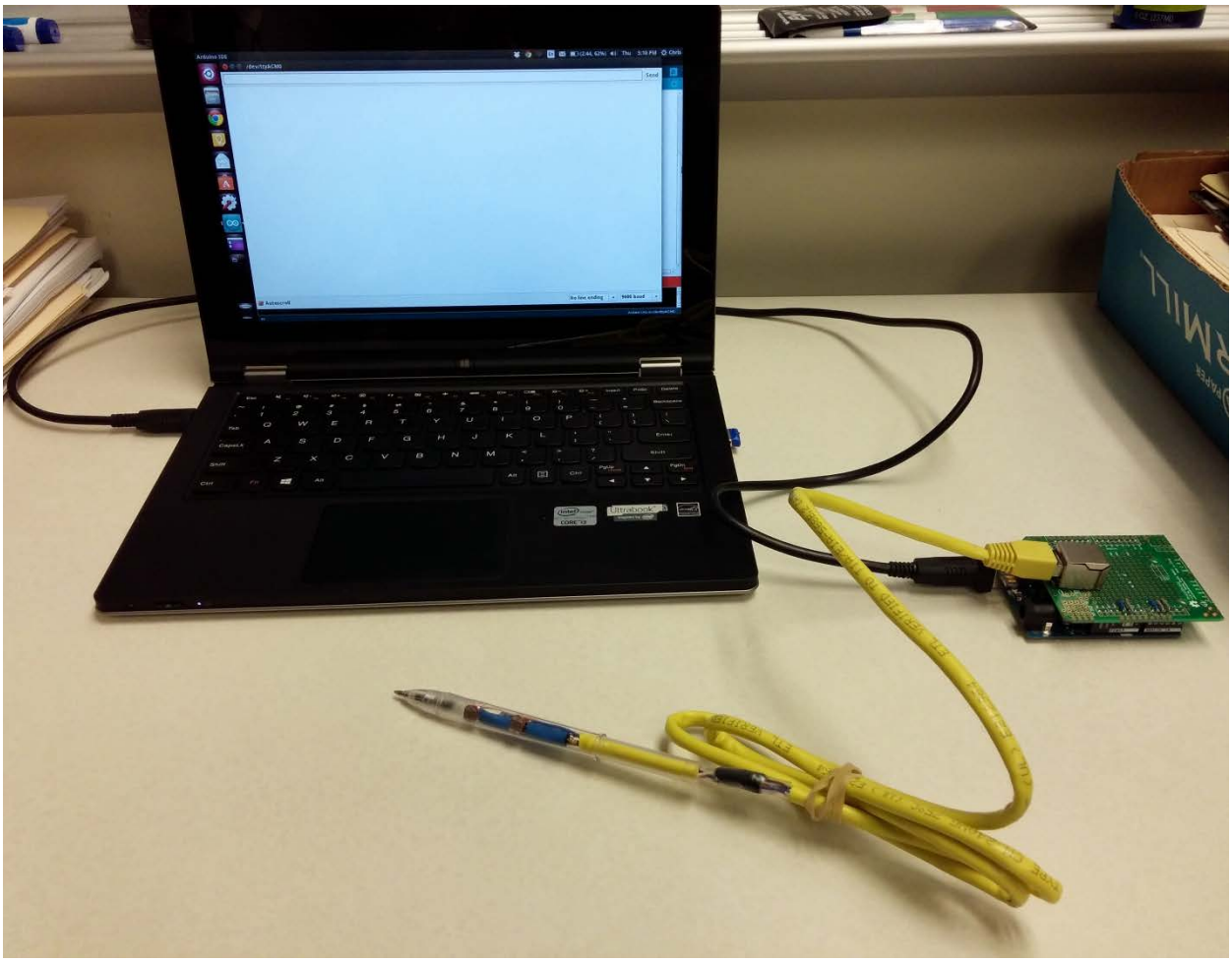

Figure 4. Physical Model

Bibliography

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