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SMART ACTIVE PEN - AN ACTIVE PEN WITH HUMAN INTERACTION DETECTION ANF SELF-RECHARGE TO ENHANCE THE WRITING EXPERIENCE

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Smart active pen –an active pen with human interaction detection and self-recharge to enhance the writing experience

Abstract

Although writing with a pen in our hand is a regular action in our daily lives, the writing method is a very complex fine movement of visual and tactile integration, visually affecting the lines, and the tactile execution of the pen and fingers of the fine muscle exertion. Holding a pen for a long time, causing pain in the muscles at the front of the index finger, the outside of the joint at the front of the middle finger, and the joint at the front of the thumb.

Pen holding posture will not only impact the writing experience but also our health---- Medical research found that long time wrong pen holding posture will cause hunched over and short-sighted! The impact of pen holding action is so great, it is important for us to have a correct and comfortable pen holding posture.

Content

Medical research found that the biggest cause of myopia is not that the eyes are traditionally considered too close to books but caused by the wrong pen holding posture. According to the analysis, when children maintain a standard sitting posture, if the thumb holding the pen is pinched or crossed with the index finger, the fingers will block the line of sight, so that he cannot see the nib clearly, and he is forced to bow his head or tilt his head to the left, thereby narrowing the distance between the eyes and the book, increasing the incidence of myopia, and accelerating the development of myopia. On the contrary, if you take the posture of not touching the thumb and the index finger, not only is the force of writing more scientific, but it will not cover the eyes, to ensure the science of the child's eyes.

Not only is the onset of myopia related to the use of wrong pen holding postures, but also the deepening of diopter.

Here we provide a solution to detect pen holding posture. According to the data feedbacked, dynamically modified the centroid of pen to optimized position and give suggestion to adult the better place for him but not force him to modify the pen holding posture. Since to force adult to do big change for their writing is difficult.

On the other hand, for children, we provide a learning mode to provide the best position for them to learn the correct pen holding posture since their writing habit is not formed and it is

easier and better for children to modify their pen holding posture before bad behavior formed. Here we provide a method to provide good writing experience by:

- Active pen side:
 - Electrospinning force sensor to detect the handwriting force and handwriting position.
 - Liner step motor to dynamic move the centroid.
 - Algorithm in pen side to fuse all data of different sensors and optimize the centroid.
 - One piezo layer to self-recharge the active pen while user using the pen to decrease the of battery life of the addon module.
 - Tile sensor to detect writing angle of pen and warning user in software side.
- Software daemon side:
 - To detect child or adult and give different suggestion by picture in laptop.

The following is the structure.

Software daemon will do the followings:

1. If algorithm in pen detecting it is child, turn on "posture correct mode". There is a graphic to show the wrong posture and wrong tilt. Of course, how to correct your writing posture.
2. If algorithm in pen detecting it is adult, give suggestion for adult.

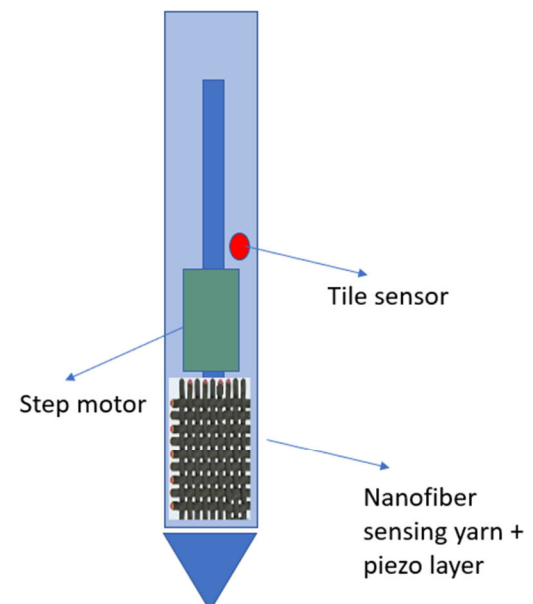


Picture in daemon:

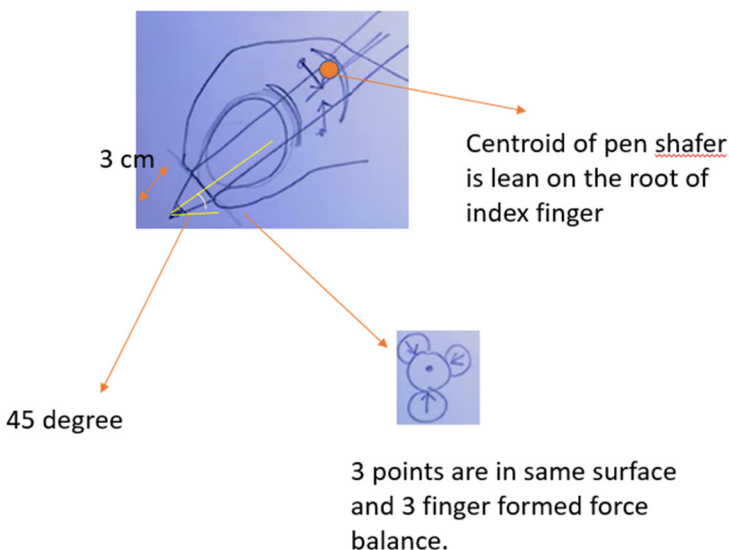
- Grip strength is excessive ,suggest relax a little.
- Finger is not in the same horizontal level , please move your contact fingers.



Software in host to warn user's wrong writing posture



In the correct pen handling method, the thumb, index finger and middle finger are held on the same link of the height of the pen shaft, 3 cm away from the nib, the pen shaft naturally leans on the root of the index finger, and the pen shaft is 45° with the writing surface, which is the most correct way to hold the pen.

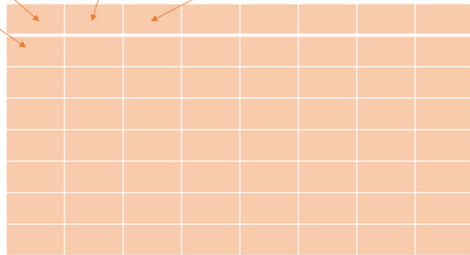


We use nanofiber sensing yarn obtained by wrapping piezoresistive elastic nanofibers around stretchable fibrous core electrodes. The fabric sensor has a fine hierarchy, from one-dimensional macro yarn to sub-micro elastic nanofibers and an internal nanocarbon tube seepage network.

In terms of material and structural design, by embedding elastoresistivity carbon nanotubes in PU nanofibers and wrapping them in retractable fiber-shaped core electrodes, fine sensing micro/nanostructures and efficient conductive networks have been successfully constructed on fiber and textile substrates, and multi-mode sensing capabilities have been realized.

By the pressure arrays, we can know the position and force value of each sensor and by that knowing the position your finger touched as well. We use the liner step motor to modify the centroid of pen. The weight of metal M is presetting in designing phase to make sure it can dominate the centroid of pen. The orthographic projection of the new centroid should on the root of index finger. The shift offset is according to the algorithm "centroid".

- The data structure of force sensor is two dim vector
- { [(x1,y1),force], [(x2,y1),force], [(x3,y1),force], [(x4,y1),force],.....
[(x1,y2),force],.....}

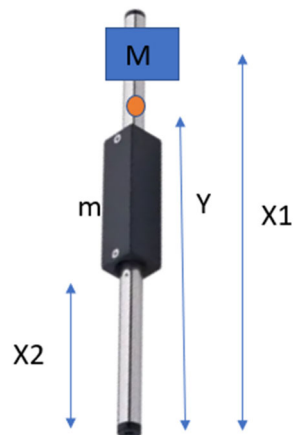


We use liner step motor to move the metal M to dynamic moving the centroid according to the following equation. m is the weight of step motor; M is the weight of metal block.

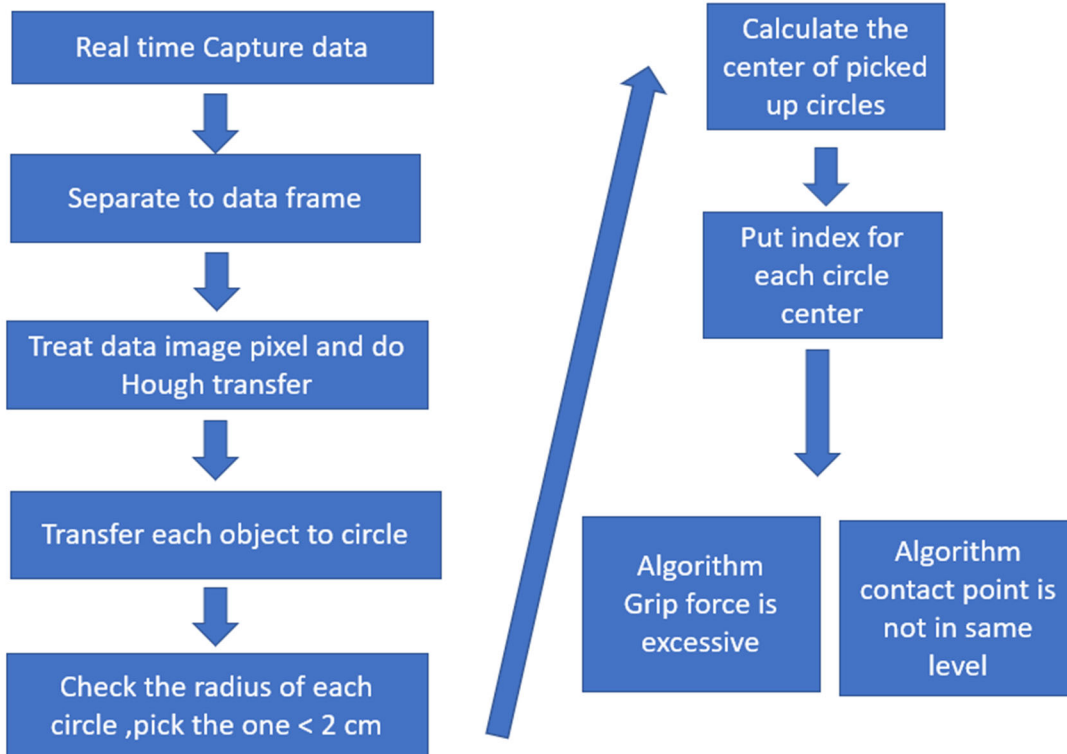
The equation is as following

$$M * X1 + m * X2 = M(\text{centroid}) * Y$$

We can accord the presetting x2 and known Y which is detected by sensor to change the X1 position.



The following is the code flow for contact point detection.



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