Posture Pendant: A Customizable Wearable Trainer - James Zhang

Background and introduction: Poor posture affects 1 in 4 U.S. adults who experience daily back pain (Getting It Straight, 2024) and 65.3% of children and adolescents (Yang et al., 2020), with low back and neck pain accounting for $134.5 billion in U.S. healthcare spending, the highest of any health condition (Dieleman et al., 2020). My scoliosis diagnosis this year raised my awareness. This inspired Posture Pendant, a customizable pendant (Figure 1) that tracks posture in real time, vibrates when slouching is detected and generates reports through a companion app (Figure 2) along with personal posture calibration. Existing posture devices are often bulky or medical-looking, which discourages regular use. Some use sticky pads that can irritate skin or invoke allergies. Others sit high on the neck, making them hard to use with tall chairs or headrests and difficult to adjust for people with limited flexibility, while poor posture already causes flexibility issues. My innovation solves these problems by being discrete, easy to wear and cost efficient. Unlike existing devices, it looks like jewelry and eliminates social stigma

Design: The prototype was built using a Seeed Studio Xiao ESP32S3 as the main board with built-in Bluetooth, an MPU-6050 accelerometer and gyroscope for sensory and a small vibration coin motor for the reminders (Figure 3). The casing was designed in CAD and 3D-printed. I tested by having participants wear the pendant with vibration off for a few minutes, then on.

Results: Multiple testing among adolescents confirmed 15-37 (Figure 4-6) percentage point posture improvements when vibration feedback was on, compared to without it; and excellent posture time increased by 1.7x to 16.4x across participants. Participants found the app easy to use and calibration useful. The overall data proves that my trainer successfully addresses poor posture through a wearable device that encourages use. Future improvements include other forms of wearing and personalized analysis from the app. Many thanks to my parents and participants.

References and bibliography:

Dieleman, J. L., Cao, J., Chapin, A., Chen, C., Li, Z., Liu, A., Horst, C., Kaldjian, A., Matyasz, T., Scott, K. W., Bui, A. L., Campbell, M., Duber, H. C., Dunn, A. C., Flaxman, A. D., Fitzmaurice, C., Naghavi, M., Sadat, N., Shieh, P., . . . Murray, C. J. L. (2020). US health care spending by payer and health condition, 1996-2016. *JAMA*, *323*(9), 863. https://doi.org/10.1001/jama.2020.0734

Espressif Systems. (2023). ESP32-S3 Series datasheet [Report]. https://files.seeedstudio.com/wiki/SeeedStudio-XIAO-ESP32S3/res/esp32-s3_datasheet.pdf

Figueira, V., Silva, S., Costa, I., Campos, B., Salgado, J., Pinho, L., Freitas, M., Carvalho, P., Marques, J., & Pinho, F. (2024). Wearables for Monitoring and Postural Feedback in the work Context: A scoping review. *Sensors*, *24*(4), 1341. https://doi.org/10.3390/s24041341

Getting it straight. (2024, June 20). NIH News in Health. https://newsinhealth.nih.gov/2017/08/getting-it-straight

Yang, L., Lu, X., Yan, B., & Huang, Y. (2020). Prevalence of Incorrect Posture among Children and Adolescents: Finding from a Large Population-Based Study in China. iScience, 23(5), 101043. https://doi.org/10.1016/j.isci.2020.101043

Appendix

Figure 1

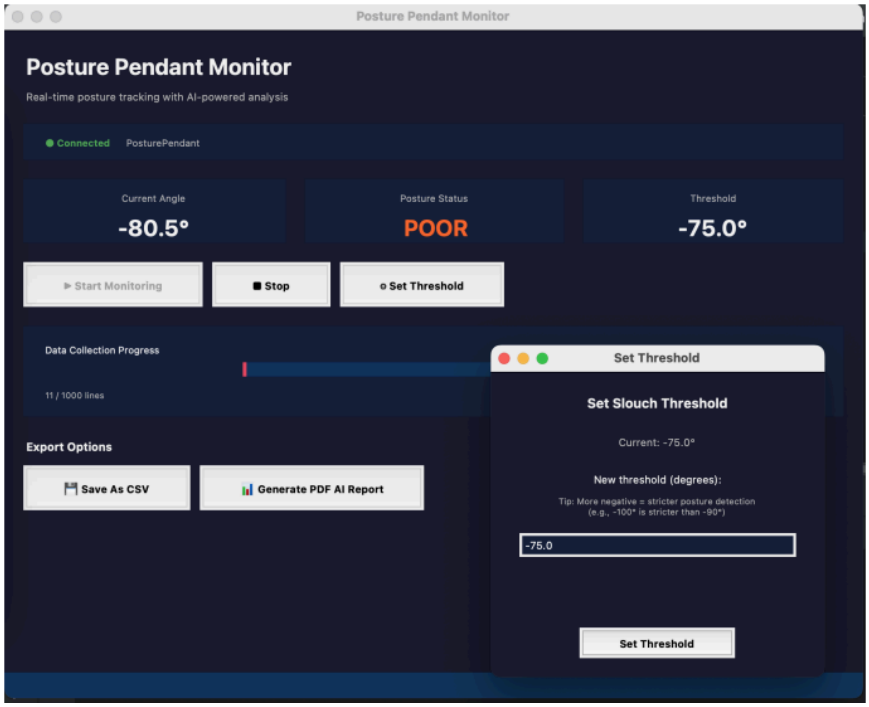

Figure 2

Figure 3

Without vibration With vibration

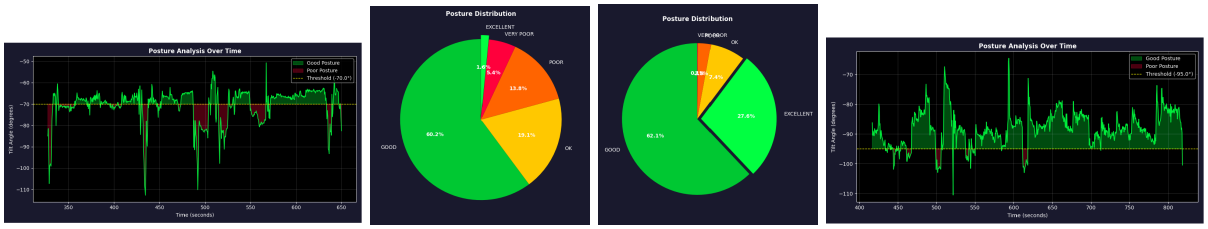

Figure 4 (sample 1)

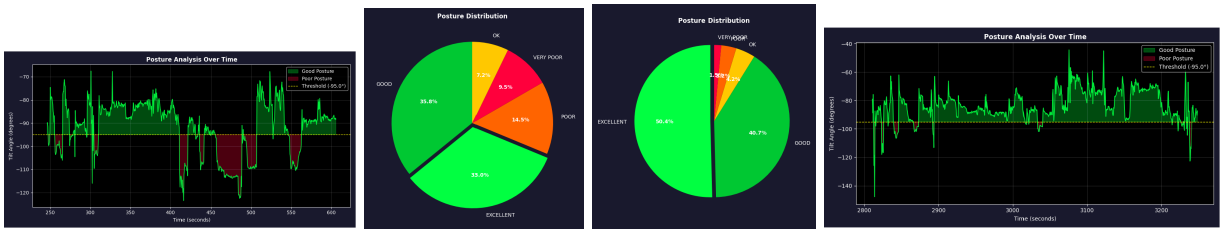

Figure 5 (sample 2)

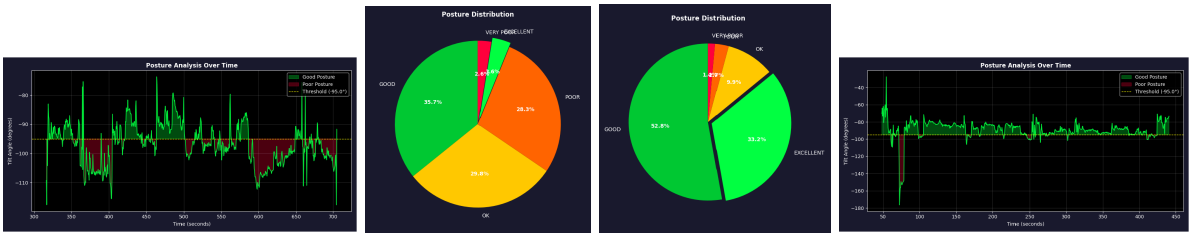

Figure 6 (sample 3)