Sitting Posture Corrector App on Raspberry Pi Using Edge AI

A realtime posture correction system

Pranav, Shreyas, Ashwin, Ronalda, Veningston

ACM India Winter School on Edge AI (Hackathon) @ IISc, Bangalore

January 4, 2026

Problem

- Works **on-device**
- Single camera in a **side view**.
- **MoveNet (TFLite)** estimates 17 body keypoints in real time.
- A calibrated scoring module maps posture deviation to **Score** $\in [0, 100]$.
- Raises warning to indicate **Good / Bad** posture.
- Moreover, we also suggest the reason for the bad posture to help identify corrective measures.

Problem

- Posture refers to the natural way one holds their body.
- In this project, we are analyzing desk posture, specifically through 2 parameters,
  1. Neck Slouch
  2. Torso Slouch

  through a side view camera and a Raspberry Pi.
- Goal: Detect sitting posture in real time and provide **actionable feedback** using a **0–100 score** and **warning**.
- We also aim to track **Focus Time** and **Idle Time** and alert the user about the same.

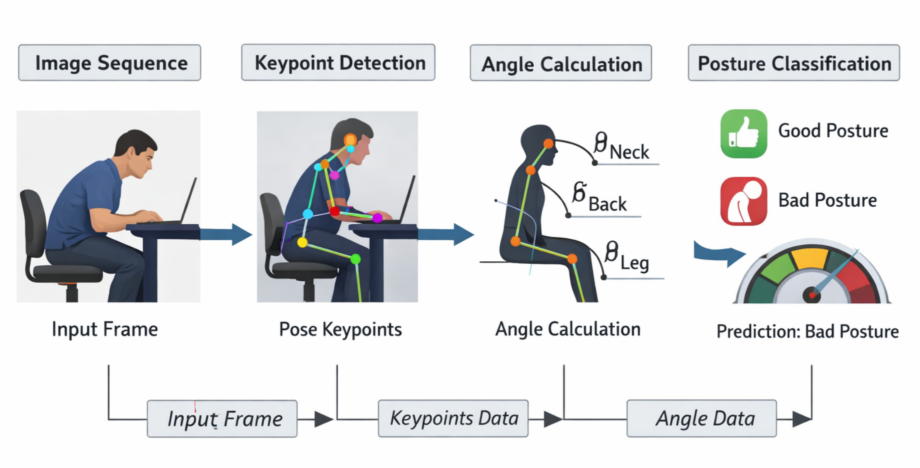

Figure 1: End-to-end pipeline for posture monitoring in side view: input video frames → MoveNet keypoint extraction → angle computation → posture prediction and score visualization.

Hardware & Deployment

- **Edge device:** Raspberry Pi (camera)
- **Compute:** On-device inference with `tflite_runtime`
- **Privacy:** Video stays local; only score/warning output leaves the pipeline

Pose Estimation with MoveNet

MoveNet outputs keypoints

$$KP = \{(x_i, y_i, c_i\}_{i=1}^{17}$$

where, x_i, y_i, c_i are normalized coordinates and confidence. Interest points from head, shoulder, hip.

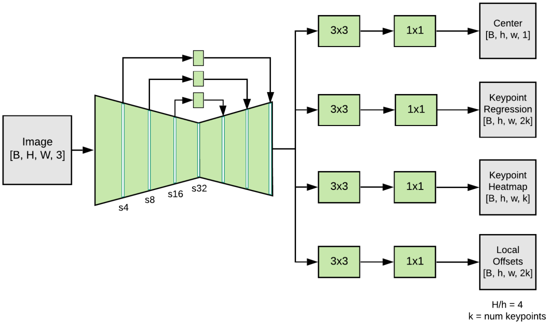

Figure 2: MoveNet Architecture

Calibration & Scoring Configuration [1/3]

Runtime & Keypoint Settings

- Frame resolution: **640×480**, frame rate: **30 FPS**
- Minimum keypoint confidence: $c_{\text{min}} = 0.3$ (ignore low-confidence joints)
- Time scaling for testing: **TIME_RATE = 30.0** (accelerated evaluation)

Alert & Session Timing

- Bad posture alert after sustained deviation: **10 s**
- Idle alert after continuous sitting/standing: **30 min**
- Focus session minimum duration: **5 min**

Calibration & Scoring Configuration [2/3]

Angle Calibration (Reference Ranges)

- **Neck angle** (ear–shoulder–hip):

$$\text{NECK\_MIN} = 130^\circ,\ \text{NECK\_OPT} = 180^\circ,\ \text{NECK\_MAX} = 200^\circ$$

- **Torso angle** (shoulder–hip–knee):

$$\text{TORSO\_MIN} = 45^\circ,\ \text{TORSO\_OPT} = 90^\circ,\ \text{TORSO\_MAX} = 135^\circ$$

Degrees change to count as head movement

- Movement-change thresholds (to detect activity):

$$\Delta\theta_{\text{head}} \geq 10^\circ, \quad \Delta\theta_{\text{leg}} \geq 10^\circ$$

Calibration & Scoring Configuration [3/3]

Final Posture Score (0–100)

$$\text{Score} = W_{\text{neck}} \cdot S_{\text{neck}} + W_{\text{torso}} \cdot S_{\text{torso}}, \quad W_{\text{neck}} = 0.5, \ W_{\text{torso}} = 0.5$$

$$\text{Good posture if Score} \geq \mathbf{75}$$

Video Demo

Algorithm Outline

1. Capture frame, preprocess to MoveNet input size.
2. Run MoveNet inference $\rightarrow$ keypoints $\{(x_i, y_i, c_i)\}$.
3. Apply confidence gating; compute head/shoulder/hip and other midpoints.
4. Extract angle features: neck flexion, torso slouch.
5. Drive ALERT based on Score and hold time.

Resource Footprint (CPU & RAM)

- Measure CPU utilization and RAM usage.
- Report peak RAM and average CPU load.

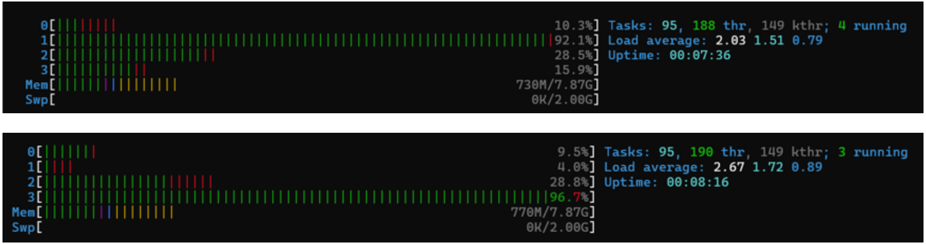

Figure 3: Memory Footprint (No Inference vs. With Inference)

End-to-End Dataflow of the Mobile App

1. **Periodic Activity Logging on RPi** - The posture monitoring pipeline runs continuously to record **activity log every 10 seconds** and **append locally to CSV files** to enable lightweight storage and offline availability.
2. Flask server running on Rpi serves this data as JSON responses using an custom API.
3. The **Flutter-based Mobile App** periodically requests the JSON data over the local network (Wi-Fi/hotspot), parses the response, and visualizes user activity in a dashboard.
   - Posture score trends over time,
   - Good vs. bad posture duration summaries,
4. **End-to-End Data Flow**

   Pose & Scoring (RPi) $\rightarrow$ CSV Logs (every 10s) $\rightarrow$ Flask API (JSON) $\rightarrow$ Mobile App $\rightarrow$ Dashboard

Conclusion

- EdgeAI posture corrector runs locally on Raspberry Pi with real-time feedback.
- Calibration enables robust scoring under a single camera view.

Future Work

- Multi-view posture estimation (for true 3D triangulation).
- Upgrade from single-person MoveNet to a multi-person pose pipeline (detect persons $\rightarrow$ run pose per ROI)
- Expand classes (e.g., asymmetric sitting, phone neck).

BBC News.
"Sitting straight 'bad for backs" (BBC News, 2006).
http://news.bbc.co.uk/2/hi/6187080.stm.

Yi-Lang Chen et. al.,
"Postural Variabilities Associated with the Most Comfortable Sitting Postures: A Preliminary Study".
Healthcare (Basel), 6;9(12):1685, 2021.
https://doi.org/10.3390/healthcare9121685.

Yuri Kwon et. al.,
"The effect of sitting posture on the loads at cervico-thoracic and lumbosacral joints".
Technol Health Care. 26(Suppl 1):409–418., 2018.
https://doi.org/10.3233/THC-174717.

Donald D et. al.,
"Sitting biomechanics Part I: Review of the Literature".
Journal of Manipulative and Physiological Therapeutics, Vol 22(9), 594-609, 1999.
https://doi.org/10.1016/S0161-4754(99)70020-5.

Oana-Ruxandra Stincel et. al.,
"Assessment of Forward Head Posture and Ergonomics in Young IT Professionals – Reasons to Worry?".
Med Lav. 114(1), 2023.
https://doi.org/10.23749/mdl.v114i1.13600.

David A Titcomb et. al.,
"Evaluation of the Craniovertebral Angle in Standing versus Sitting Positions in Young Adults with and without Severe Forward Head Posture".
Int J Exerc Sci. 17(1):73–85., 2024.
https://doi.org/10.70252/GDNN4363.

Dae-Hyun Kim et. al.,
"Neck Pain in Adults with Forward Head Posture: Effects of Craniovertebral Angle and Cervical Range of Motion".
Osong Public Health Res Perspect. 9(6):309–313, 2024.
https://doi.org/10.24171/j.phrp.2018.9.6.04.

Physio-Pedia.

"Craniovertebral angle".
https://www.physio-pedia.com/Craniovertebral_angle.

Thank you!

Questions?