



PoseRight

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Problem Space

The rapidly increasing use of laptops and smartphones has resulted in an increasingly adverse impact on the health of people. Poor posture is a source of partially preventable physical stress that can cause chronic pain later in life. We spend a lot of our working life these days sitting in front of a screen. In this setting, we tend to unconsciously take different postures throughout the day. Some of which are bad postures such as cradling phones with our shoulders, craning our necks toward the screen and hunching our backs. As the workday progresses, the likelihood of taking up bad postures such as slouching increases.

According to Taieb-Maimon(2012)¹, the prevalence of musculoskeletal symptoms among persons with frequent computer use, 3-5 hours a day, ranges from 40% among college students, 50% among new workers in the first year on the job to over 70% of university staff and students. About one-third of all the injuries and sick days away from work in the US workforce was as a result of musculoskeletal disorders. This has both health and financial implications because 74% of those with musculoskeletal disorders or injuries have applied for workers' compensation.

With PoseRight, we set out to help users maintain good posture throughout their workday. Existing efforts to solve this problem require the use of expensive wearable devices or other interventions that can be inconvenient to use.

Competitive analysis

Types of interventions that exist currently are:

- Engineering interventions include, for example, changes in keyboard or mouse designs or wrist supports. It's important to note that laptops are not ergonomic by design and require docking stations to make them more ergonomic to use.

¹ The effectiveness of a training method using self-modeling webcam photos for reducing musculoskeletal risk among office workers using computers <https://www.sciencedirect.com/science/article/pii/S0003687011000731>



Ergonomic mouse and keyboard: Sourced from Microsoft.com

- Personal/behavioral interventions include wearables such as wearing arm splints, back braces, exercise programs, and electromyographic biofeedback. Wearables require you to spend some extra money to acquire them. Sometimes users may forget to carry them or in some cases charge them. In the case of the Lex bionic chair, users have to walk around with their chair. With PoseRight we envision creating a tool that you cannot forget to carry, forget to charge and discreet to use.



Back braces and wearables like Upright Go. Source: Amazon.com



Lex bionic chair²

- Ergonomic interventions generally include both ergonomic adjustments to the workstation to tailor the physical conditions to the worker's physiology and working patterns as well as educational components about correct sitting posture. With PoseRight, we intend to educate our users on how to set up their workstation so that it serves them right in terms of keeping good posture.

² Lex Bionic chair

<https://www.kickstarter.com/projects/789968633/lex-bionic-chair-that-enhance-posture-comfort-and>

Related Work

Due to the rapid growth of smartphones, mobile devices and laptops, a lot of research has been conducted in order to capture, monitor, and analyze data from sensors embedded in those devices in health related areas. Krishnan(2014)³ found that the webcam motion tracking approach is a feasible low-cost solution to perform real-time movement analysis and training for people who need physical therapy to recover locomotion. Research has been done in monitoring posture to prevent unhealthy neck postures when using a smartphone⁴⁵ using inbuilt sensors to create awareness among users. There have also been studies to examine the effects of multicomponent intervention on postural behaviour on a workstation⁶. Here the participants were recorded by an external camera and received immediate feedback on whether they were in a safe or at-risk posture. Participants received verbal and physical guidance to demonstrate a safe posture, if necessary. Some also use use different types of sensors to monitor body posture and then provide feedback in the form of prompts⁷. Though a lot of effort is put into setting up ergonomic workstations and educating people about posture, research⁸ shows that sometimes just training the user about ergonomics is not enough and motivational interventions need to be set up to achieve lasting behavioural change.

³ <https://onlinelibrary.wiley.com/doi/full/10.1111/nej.12055>

⁴ Lawanont, Worawat & Mongkolnam, Pornchai & Nukoolkit, Chakarida. (2015). Smartphone posture monitoring system to prevent unhealthy neck postures. 331-336. 10.1109/JCSSE.2015.7219819.

⁵ Lee, Hosub & Sang Choi, Young & Lee, Sunjae & Shim, Eunsoo. (2013). Smart pose: Mobile posture-aware system for lowering physical health risk of smartphone users. Proceedings of CHI '13 Extended Abstracts on Human Factors in Computing Systems. 2257-2266. 10.1145/2468356.2468747.

⁶ Sigurdsson SO, Austin J. Using real-time visual feedback to improve posture at computer workstations. *J Appl Behav Anal.* 2008;41(3):365–375. doi:10.1901/jaba.2008.41-365

⁷ Kwangsu Moon & Shezeen Oah (2013) A Comparison of the Effects of Feedback and Prompts on Safe Sitting Posture: Utilizing an Automated Observation and Feedback System, *Journal of Organizational Behavior Management*, 33:2, 152-162, DOI: [10.1080/01608061.2013.785906](https://doi.org/10.1080/01608061.2013.785906)

⁸ Sigurdur O. Sigurdsson, Melissa Artnak, Mick Needham, Oliver Wirth & Kenneth Silverman (2012) Motivating Ergonomic Computer Workstation Setup: Sometimes Training Is Not Enough, *International Journal of Occupational Safety and Ergonomics*, 18:1, 27-33, DOI: [10.1080/10803548.2012.11076912](https://doi.org/10.1080/10803548.2012.11076912)

Product Vision

PoseRight was created to create awareness about how people put their bodies (posture) and to keep people motivated to use safer postures when they are sitting and working on their computers. PoseRight's user is a health-conscious individual who spends long periods of time working on a computer. They often lose track of how they are using their bodies because they are focused on the task at hand. They welcome a creative/innovative tool that gently inspires them to make small posture changes throughout the day.

Poseright focuses on the back, neck and shoulders posture (which are usually in-view from a webcam). We work with cameras on devices such as laptops and desktops, not mobile devices. We will devise the most effective way of communicating when a user is taking up a posture that isn't good for them. There are two main ways; real-time feedback using notifications and delayed summarized feedback.

Product Description

PoseRight is a web application that runs on a web browser. We chose to make it a web application because most users work with browsers and are often online when working on their computers. Additionally, making it a web application meant that users do not require to download any software to start using it. PoseRight is a low-cost intervention because all that is required is a computer's webcam to track posture. Future iterations of PoseRight will run on the client side as a browser extension so that users do not have to keep a tab open in order to keep track of their posture.

Generative Research

We conducted semi-structured qualitative interviews with specialists to understand the problem of posture and what people's attitudes are towards their posture.

Semi-structured qualitative interviews

We interviewed UC Berkeley campus ergonomist, Mallory Lynch, who says that 85% of people on Berkeley campus simply don't care about keeping good posture. 'They feel invincible because the consequences of poor posture are not often immediate. The one successful motivational force to keep good posture is physical pain. When you are in pain you pay more attention to how you hold your body'.

We also interviewed an occupational therapist, Hanan Wasse, who works with patients who experience musculoskeletal pain to understand better what poor posture means and what's its effects are. The key takeaways were what good posture means e.g. the feet which should be firmly planted to the ground, the shoulders should be relaxed. She indicated that sitting for a long time even with good posture is harmful to you. She encourages people to take breaks and keep moving.

Surveys

Goals

We set out to understand what motivates people to keep good sitting posture and why it is important to them. We recruited ten students from the Information School, Berkeley. These students spend on average more than six hours working with their computers. We also surveyed one-hundred Mechanical Turk users from across the US to see if findings from the two groups matched.

Hypothesis

Our proposal to employ the use of the webcam to detect a user's posture comes with concerns about personal privacy. The Health Benefits Model(HBM) theorizes that people will take action to prevent the risk of disease or a health problem if their perceived benefits of taking action are greater than the perceived barriers. We hypothesize that users are would be willing to overlook the use of the webcam if they are able to see benefits in improved posture as a result of the tracking.

Perceived benefits - perceived barriers + cues to action(reminders) + self-efficacy(agency)

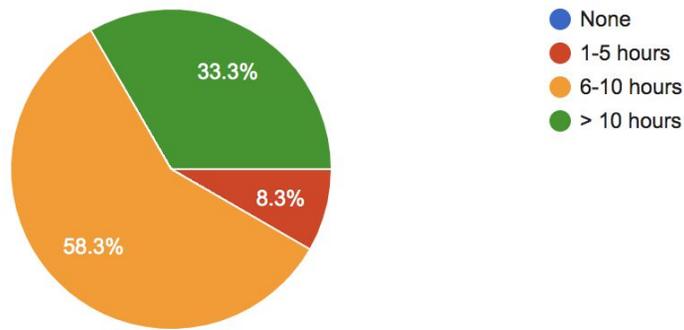
Ethnographic and empirical studies have shown that how an individual behaves is affected by their peers. Liao(2018)⁹ found that social support is beneficial and effective in encouraging teenagers to maintain good posture. Additionally, the social cognitive theory stipulates 'that a person can be both an agent for change and a responder to change. Thus, changes in the environment, the examples of role models, and reinforcements can be used to promote healthier behavior'. We hypothesized that users would be willing to share posture information with one another in order to keep each other in check.

Key takeaways

On the question of what motivates people to keep good posture, we learnt that it is more than the concern of musculoskeletal pain later on. Our respondents indicated that posture shows one's attitude towards life. Having good posture is important to them because they want to appear taller and more confident.

58% of our respondents spend 6-10 hours in front of a computer. 8.3% spent 1-5 hours and 33% spend more than 10 hours on a computer.

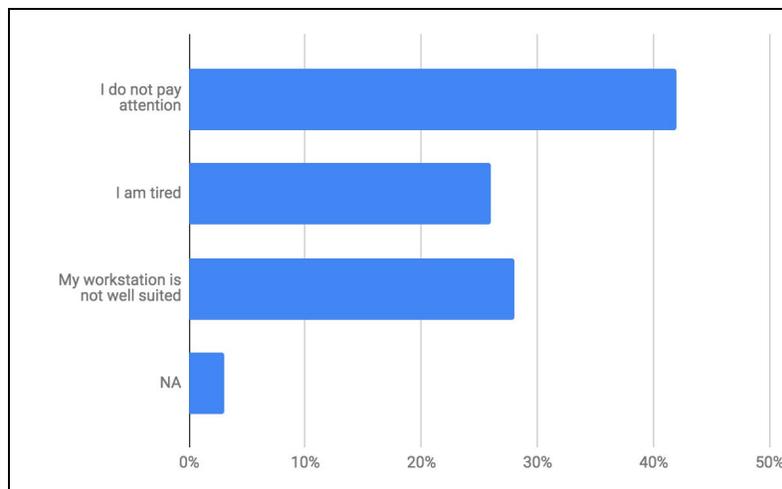
⁹ <https://pdfs.semanticscholar.org/24aa/2618d6c15226bba75c19460158fa07f56c3a.pdf>



Amount of time spent on the computer

When it comes to awareness, 97% of those surveyed agree that they do take up poor posture when sitting in front of their computers. When we asked about what they believe is the cause of this:

- 42% attribute poor sitting posture to absent-mindedness
- 26% to tiredness
- 28% to having a poor workstation



Reasons for poor posture

Since PoseRight would require our respondents to allow use of the webcam, we sought to understand whether they would be willing to allow PoseRight to use it. The majority would not want to have their webcam used to assess their posture. However, 1 in 4 were willing to try it.

On the subject of sharing posture data with family and friends.. Close to 80% of our respondents indicated that they would prefer to keep this information private to themselves.

Ideation & Design Process

We implemented the sprint framework process in our ideation process. The user research and talking to experts was the first part of the task. The next task was developing ideas around the goal we had of a low-cost tech solution than anyone can spin up and use to track their posture.

We used sticky notes and scratch paper to individually answer these key questions.

- Who is the target user?

At first we thought students were a good target audience as they spend a lot of time working with computers. However, students often don't have permanent workstations and so we expanded our user segment to include students and computer users who work in organizations(generally, anyone who works with laptops for long periods of time).

- What device do they use? Do they use laptops or desktops?

The fixed nature of desktops lend themselves as a viable platform because there aren't any concerns about webcam angles with respect to the user. And laptops are more general cases as we do not have controls on where the camera is placed. We rationalized that if we built for the laptop, desktop users could also use PoseRight.

- How best can we capture posture information in a low-cost and effective way?

We explored the use of sensors and the webcam. We favored the use of the webcam because it would not require readily available on most laptops and the user does not need to incur any additional costs.

- How do we keep people motivated to keep good posture?

We explored incentives such as: working with establishments that are pro-health to give discounts to users who are able to set high posture scores.

Another way was to integrate with user's calendars and be able to correlate what activities in the day e.g. meetings are correlated with high posture scores.

Have a posture leaderboard and have groups of users compete with each other on who has higher scores.

Having users set goals at the beginning of the day about what score they will work towards before the end of the day.

Sending alerts after a period of prolonged

- How do we educate people in how to keep good posture?

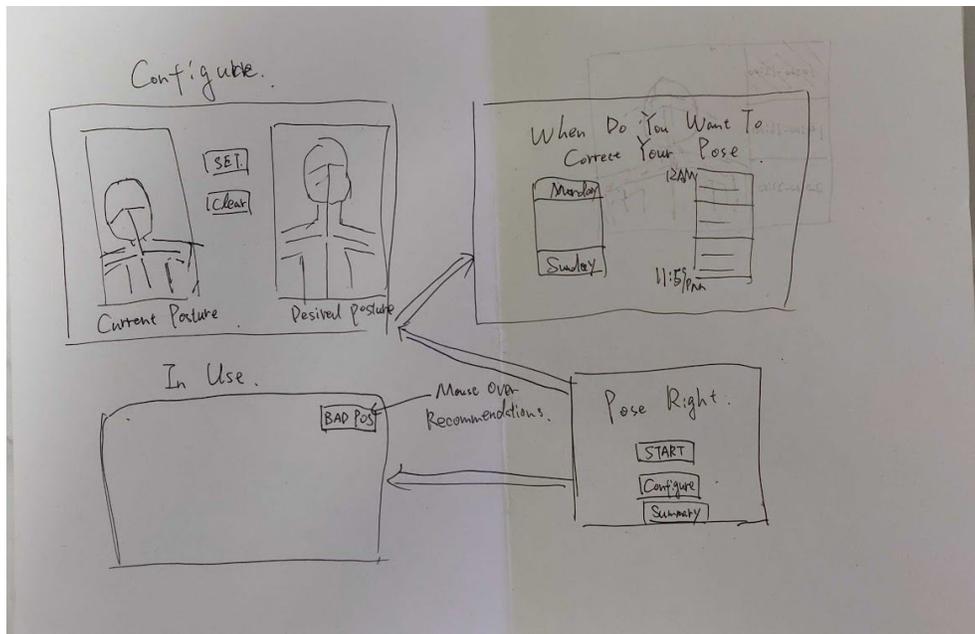
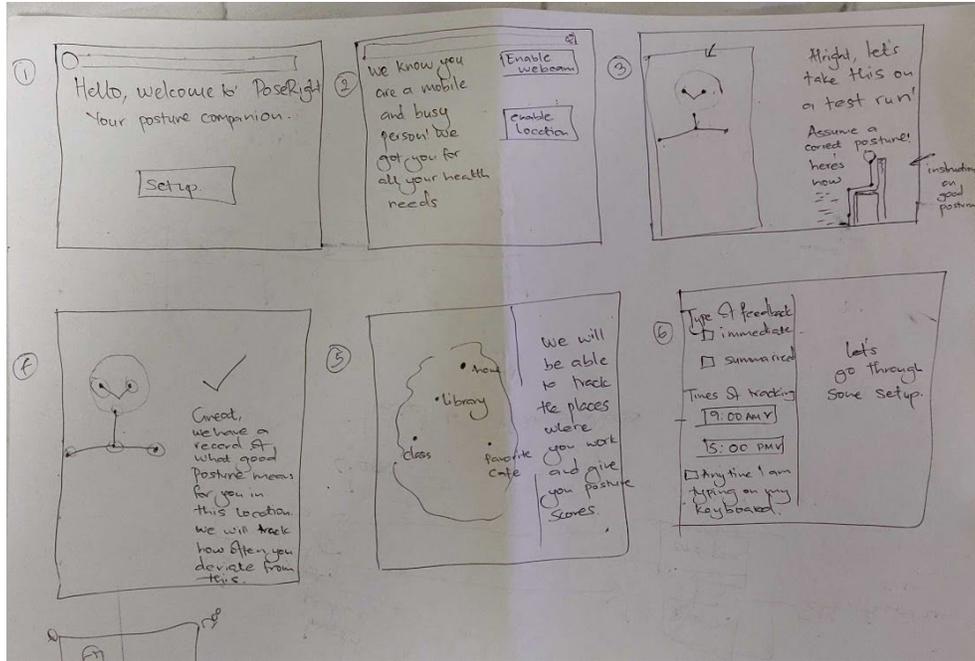
We thought we could use resources provided by the the University Health Services¹⁰¹¹ to educate people on what good sitting posture means.

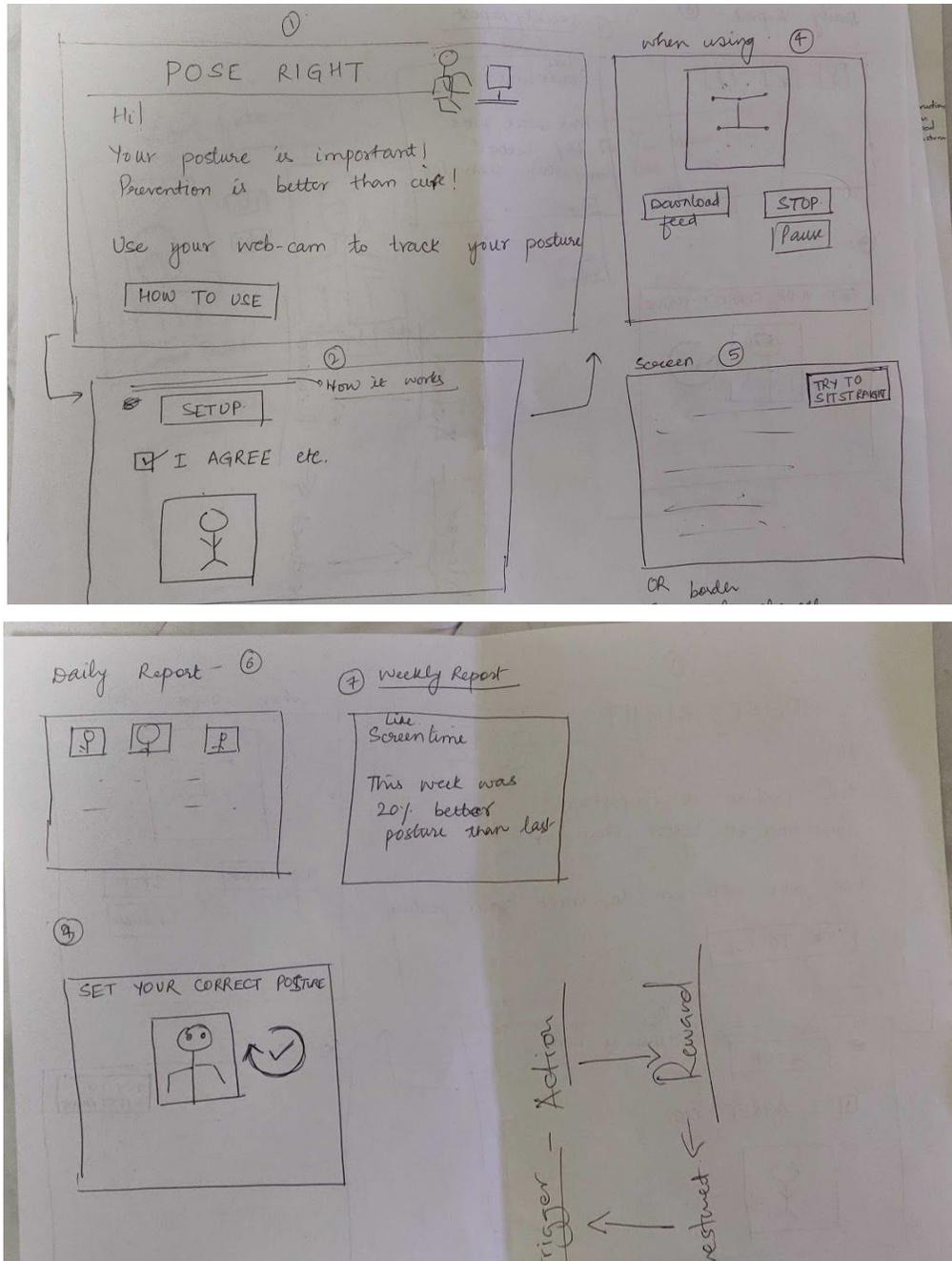
We discussed suggesting workouts to our users who had poor posture for long periods of time.

We explored ways of tracking screen time to make sure PoseRight users take breaks often.

¹⁰ <https://uhs.berkeley.edu/sites/default/files/laptopergonomics.pdf>

¹¹ <https://uhs.berkeley.edu/bewellatwork/ergonomics>





Sketches of app flow

Each one of us sketched separate designs and then combined the best of all. We discussed our sketches and made the following key design decisions:

- PoseRight will run as a browser application and future work would involve developing a native version that lives within a user's desktop.

- Allow PoseRight users to have full control over when PoseRight gets to run by allowing them to set up time limits.
- PoseRight needs to educate users on what good sitting posture means.
- PoseRight needs to provide both real time feedback through notifications when a users is in poor posture for long and summary reports. A user should be able to turn real time notifications on and off.
- Allow users to test run PoseRight so they get a sense of how accurate it is.
- Show historical posture data to the users, to help analyse improvements with the application.

Hello! Welcome to PoseRight

Your posture companion

SETUP

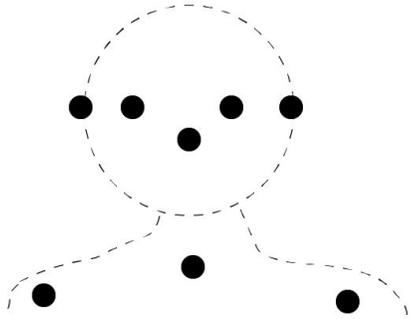
We know you are a busy person with things to do and places to be.

PoseRight is here to monitor you and track your posture as you go about your work day.

PoseRight alerts you when you are assuming poor posture and helps motivate you to keep a good posture

Enable WebCam

[Privacy Policy](#)

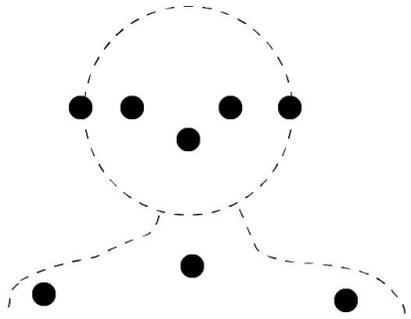


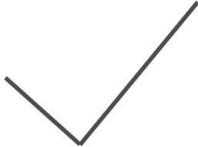
Let's take this on a test run.

Assume a good posture.
Here's how:

1. Feet planted firmly on the ground
2.
3.
4.
5.







Great, we have a record of what good posture means to you at this location.

PoseRight will track how you deviate from this.

discarded as soon as we detect their posture from the images. We then collected good and bad posture data in two sessions back to back.

1. We had our recruits sit down at a table and ensured that they were comfortable. We then asked them if they understand what good sitting posture means. Using guidelines from the UC Berkeley ergonomics department¹², we ensured they were in a good sitting posture.
2. We placed a laptop on a table in front of them and opened a blank document for them to type into. This is to simulate work on a laptop.
3. Using PoseRight, we started taking snapshots of these individuals every two seconds as they typed into the keyboard and engaged them in conversation about their posture habits.
4. After five minutes, we turned PoseRight off and kicked off the second session

The second session involved asking the users to demonstrate what poor posture means to them and capturing snapshots of this using PoseRight.

1. We placed a laptop on a table in front of them and opened a blank document for them to type into.
2. We asked our recruits to take up poor sitting postures and used PoseRight to take snapshots of them every two seconds.
3. After five minutes of different variations of poor posture, we asked our recruits to stretch.

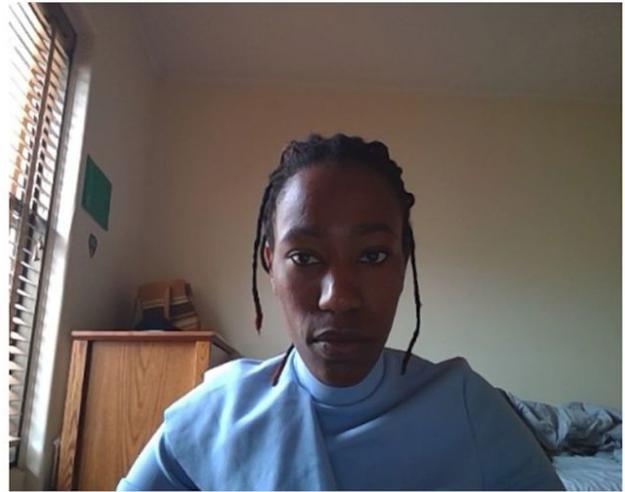
With this exercise, we collect 1768 data points that was used to train our classification model.

¹² <https://uhs.berkeley.edu/sites/default/files/laptopergonomics.pdf>

PoseRight

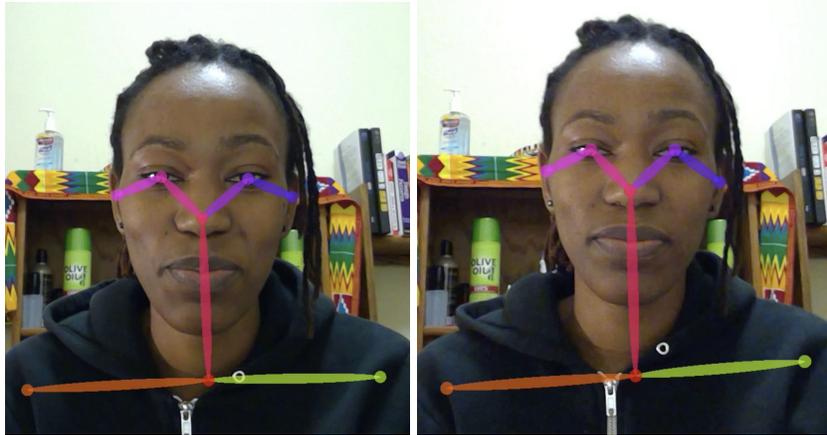
Your posture companion

This webpage will take a picture of you every 10 seconds and send it to our server where we will process the image to detect your posture. As long as this webpage is loaded, your image will be sent to us. Close this webpage to turn this off.



Example of our data collection page

OpenPose is a library for real-time multi-person keypoint detection and multi-threading written in C++ using OpenCV and Caffe. OpenPose represents the first real-time system to jointly detect a human body, hand and facial key points (in total 130 key points) on single images. In addition, the system computational performance on body keypoint estimation is invariant to the number of detected people in the image. We get a 70-keypoint face estimation and rendering and then save the result in JSON format. Therefore the distances and angles between the important key points like eyes, ears, nose, neck, and shoulder will act as features for deciding if the posture is good or bad.



Example of key points output from OpenPose

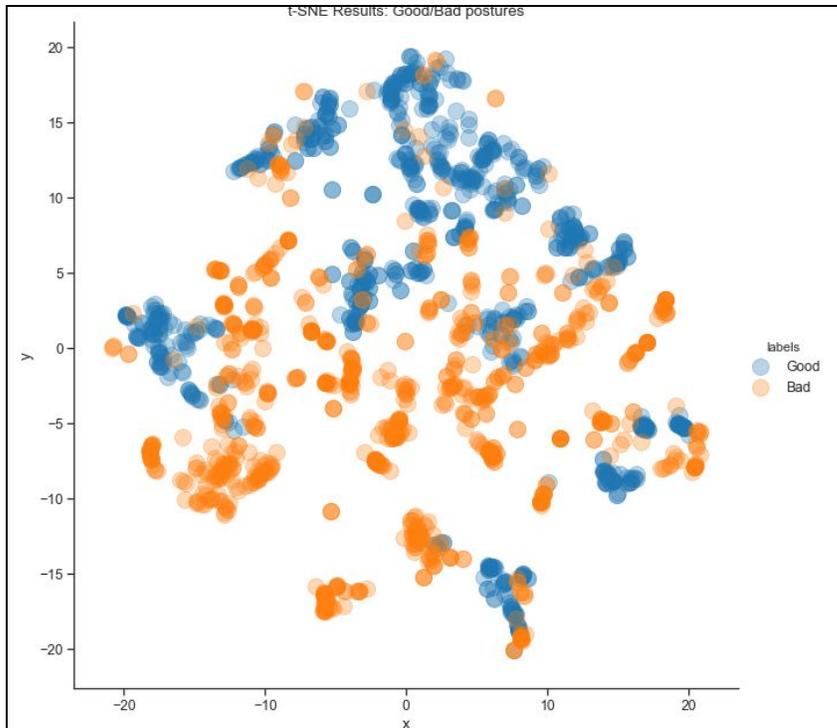
We ran¹³ OpenPose on the collected images to get the data points for the user's eyes, ears, nose, neck and shoulder positions. The blue dots represent the eyes, black for ears, green for the nose and red for shoulders and neck.

These keypoint estimates are then fed into a classification model to distinguish between good and poor posture. The model learns from the key points of the data collected from different subjects. PoseRight is good at detecting forward head posture and slouching. However, it is not very accurate in estimating posture when the back is arched up to a certain degree. This is representative of the data collected and a limitation of the current version.



¹³ [User1](#)
[User2](#)

Classification Approach

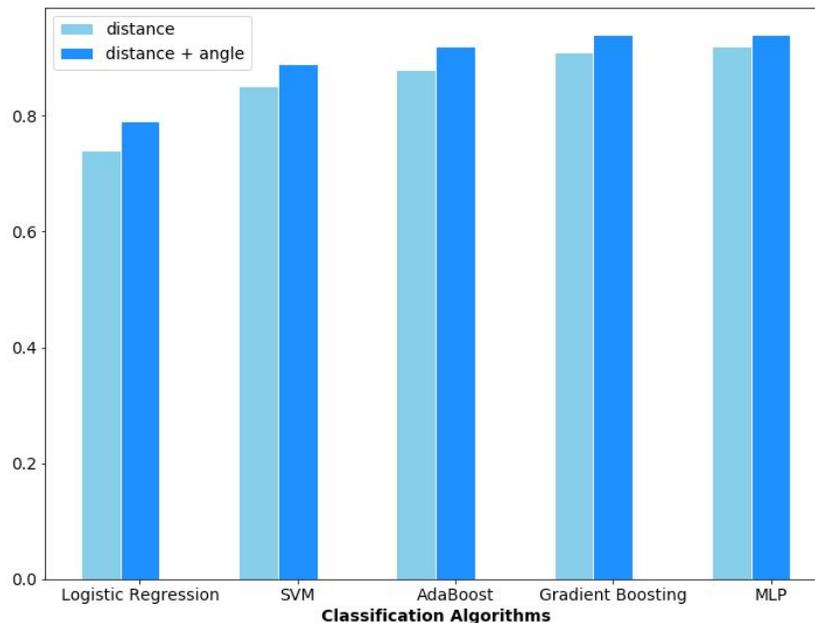


t-SNE Visualization to show the data points for good and bad posture. They exist in cluster and are separable.

We can use a classifier to detect if the posture assumed by a person is right or wrong. It will be a binary classification problem with the two classes being good and bad. This classification can either be performed directly on image data or on the OpenPose key points. Training a classifier directly on images to detect posture will be a difficult task to formulate as the classifier will first need to identify the object of interest in the image which is the user and then classifies if the pose is good or bad. This will require huge amounts of data and computing. Therefore training a classifier on the OpenPose key points (for eyes, nose, ears, shoulder, and neck) is a better approach.

We collected data on ourselves using the data collection method discussed above. Then we feed the images to OpenPose to extract 2D key points from the images. First, we did a sanity

check using t-SNE dimension reduction method to visualize if the data representing good and bad postures can be distinguished. From the figure we can see after dimension reduction to 2 dimensions, our data is nearly linear separable with only a few outliers and has a very strong potential that could be transformed to a space that is good for classification algorithms by kernel tricks.



We then trained different supervised models with different features to get the best accuracies. Given the size of our data, we explored linear models (logistic regression), SVM, ensemble models (AdaBoost and Gradient Boosting) and shallow neural networks (MLP). We used the distances between the keypoint estimates (in pixels) and then normalized them based on their first-order statistics. Furthermore, to capture bad postures like tilting head to one side, we added the angles between each pair of keypoints as the features to the model. For each image, we have features including distance and angles between nose and left shoulder, eyes and ears, etc. And our data can be represented as a vector of length 16. We got a 97% training accuracy and 94% validation accuracy on the data we currently have for our best MLP model.

Model Name	Accuracy (distance)	Accuracy (distance+angle)
Logistic Regression	0.74	0.79
SVM (with RBF kernel)	0.85	0.89
AdaBoost	0.88	0.92
Gradient Boosting	0.91	0.94
Multi-layer Perceptron (MLP)	0.92	0.94

Heuristic Approach

We experimented with a heuristics-based approach to detect bad postures without the need for data labeling. We use some predefined mathematical formula to calculate signals like the angle between the line connecting nose and neck and the line connecting neck and shoulder, and based on which we can give a prediction on the user is assuming a bad posture or not. This approach is easy to implement and interpret, however, we decide to favor learning based approach than this one for the following reasons. First of all, we do not have regulations on how users setup their cameras. Some users may sit face front to their cameras while others may face to a different angle. This variation on camera calibrations will result in having different thresholding for different users, making it infeasible in our case. However, with 3D keypoints estimation, we can alternatively build heuristic functions by calculating how much the users postures are off from their pre-calibrated good postures. So one way to tackle this problem is to use two cameras to have a 3D key points estimation but it will introduce extra cost on users and limit the portability of our system. Due to these two shortcomings. we decide to proceed with supervised learning based methods, which requires less developing and user calibration effort and will improve its performance as we collecting more and more training data.

Usability testing

The goal of the usability testing was to evaluate our design and identify pain points or confusion with the user. We wanted to know how the user felt getting feedback about their posture. How accurate they felt was the application and if they found it helpful.

The usability test consisted of the following steps-

1. Sit on a desk and chair. Start the PoseRight application.
2. The application prompts the user to enter a name or nickname to create a separate session for them
3. Set up a time duration for which they want to use PoseRight.
4. Test the application and provide feedback

We asked the users following set of questions-

1. How accurate do you think is the application in providing feedback on your posture?
2. How do you feel about getting feedback on your posture?
3. Will you use the application again? Did you find it helpful in improving posture?
4. Was getting feedback for your posture annoying?
5. What was the most frustrating part?
6. Do you feel you have control over the application and can turn it on/off when you want?
7. What other features would you like to be added to the application?

We tested our model and web prototype on six respondents and we learnt the following.

There was a common theme to the responses we received-

1. Users need context to feel comfortable using the application

Users found it a little ambiguous and confusion to start using the application. They felt they lacked context regarding the application and were not very sure as to what good or poor posture implied. Better education was needed.

2. Users want full control of when PoseRight runs

They are keen to have very granular control. At first we asked users to set sessions in hours but they preferred minutes. However, they felt that they somewhat have control as they can either directly turn it off by closing the web browser or set a small time limit. The option to remain anonymous / pseudo-anonymous by providing any nickname fostered a sense of privacy. However, there were some concerns raised regarding forgetting to turn off the application. We started with giving the user an option to enter time in hours but quickly realized minutes to be a better option.

3. Users need to know ways of correcting their posture

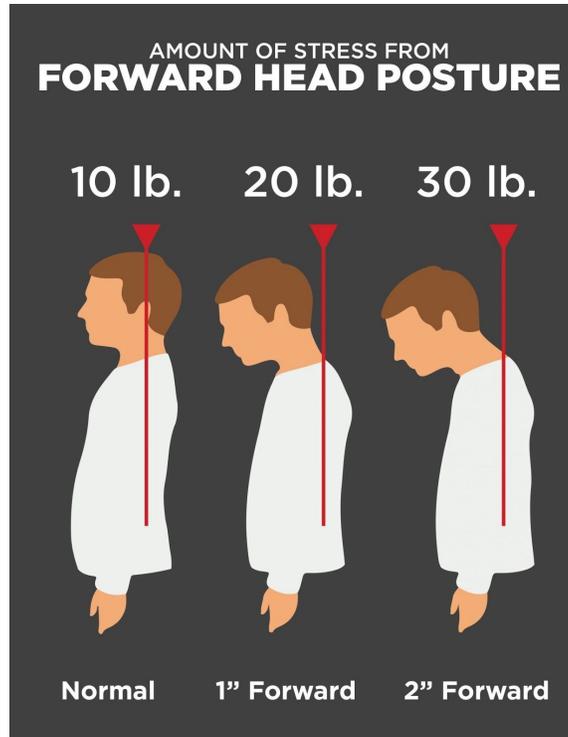
The PoseRight application gives the user a possibility to educate themselves about good posture habits. However, the University Health services brochure was very wordy and our respondents recommended that we simplify it. This led to simpler educative diagram shown in the later sections. Also, some users wanted to see what ideal posture would look like and if they can align themselves to the ideal looking at the application on their screens.

4. The best way to report about posture behavior is using time

We showed the user different mockup graphs giving details about their posture for the last x minutes. We experimented with using percentages of time the user had good or bad posture. Most users felt a high level overview of the amount of time spent in good or bad posture was helpful. They might be able to relate to granular details of their data over a greater period of time like a week rather than an hour.

5. Perceived accuracy is lower than true accuracy.

The theoretical model accuracy in classifying the posture as good or bad is close to 92%. However, this is subject to the data collected. In practice, the model is very good at correctly predicting forward head posture as opposed to slight forward arch in the lower back, which is difficult to detect using a webcam and might not be represented well in our dataset.



Examples of the forward tilt. Source: Braceability¹⁴

6. Qualifying the posture

Some users wanted to know to what degree was their posture good or bad in addition to what the ideal posture is and how can they correct it.

App flow

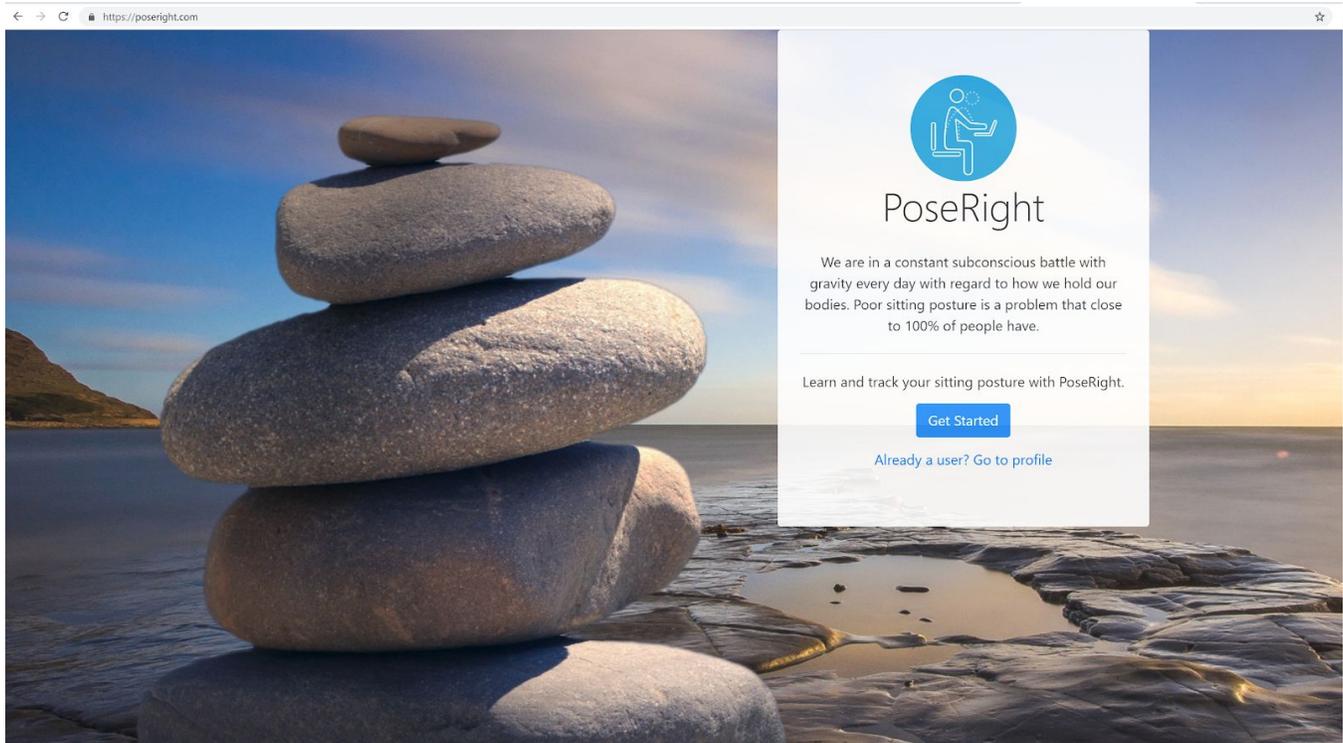
User Onboarding and Setup > Education > Tracking > Reporting

User Onboarding

PoseRight allows the user to create a session for them by entering a name/nickname. The name does not have to be the real user’s name which allows for a level of anonymity. The use of a pseudonym allows the user to close the webpage whenever they want without losing information about their posture. PoseRight does not store any image data, but in case of unexpected closure of the application the user can still see feedback on their posture and

¹⁴Braceability <https://www.braceability.com/blogs/articles/text-neck-how-smartphones-hurt-your-spine>

observe trends through a report. The onboarding process gives the user control to limit the duration for which PoseRight will run. They are prompted to enable access to the webcam and turn on notifications(If they would like to have PoseRight give real time prolonged poor posture alerts).



The landing page welcomes our users to the application. New users are taken through the onboarding funnel. Existing users can immediately access posture tracking.

First time users are asked 6 questions that assess their current habits when it comes to computer use. The last question asks them about their motivations for keeping good posture. Their motivations can be incorporated into the posture report language.

1 How many hours do you spend sitting in front of a computer?

- Less than 3 hours
- 3-6 hours
- 6-10 hours
- More than 10 hours

2 What's your primary work location?

- Mostly at home
- Mostly in the office
- Both home and office equally

3 What is your workspace setup like?

- A desktop
- A laptop connected to a monitor
- A laptop with a docking station
- Just a laptop

4 Do you experience any physical discomfort when working with your laptop/desktop?

- Very frequently
- Frequently
- Occasionally
- Rarely
- Very rarely
- Never

5 How often do you take breaks when you work?

- At least once every hour
- A few times every 6 hours
- Quite rarely

6 Why is keeping good posture important to you?

- To avoid physical pain
- To appear confident and attractive
- To avoid feeling sluggish

Next



Welcome to PoseRight!

Choose a name/nickname to go by in this session

Use the same name to track your results over more than one session

For how long do you want PoseRight to monitor your posture?

Monitor my posture for the next minutes

You can stop PoseRight any time within this time.

Let's get started

M Inbc | M Inbc | Use | Use | Coll | Pos | Goo | G type | Post | Typ | bea | heal | The | I x | +

127.0.0.1:8001/test-run?session=4977Eve

http://127.0.0.1:8001 wants to use your camera

Webcam is not loaded yet

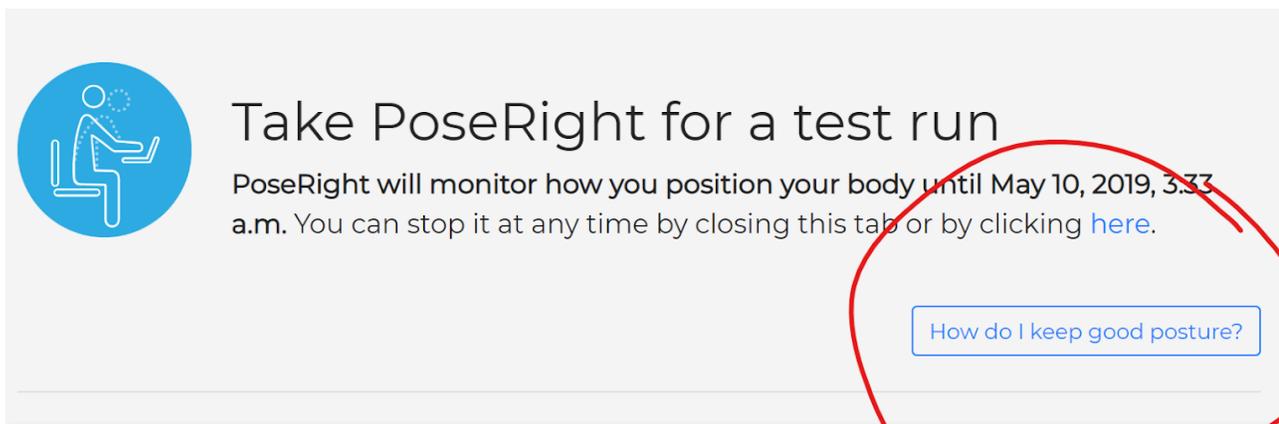
Allow Block OK

PoseRight will monitor how you position your body until May 10, 2020 at 10 a.m. You can stop it at any time by closing this tab or by clicking here.

How do I keep going?

Education

Though PoseRight tracks upper body posture ie. from the shoulders up. We thought it would be a good idea to educate our users on all aspects of good sitting posture. This means everything from the placement of the feet to how you rest your wrist and elbow on a table. Our respondents indicated to us that the current University Health Services brochure¹⁵ on good sitting posture was too wordy and so we decided to develop a version of it that would be easy for users to capture the key points.

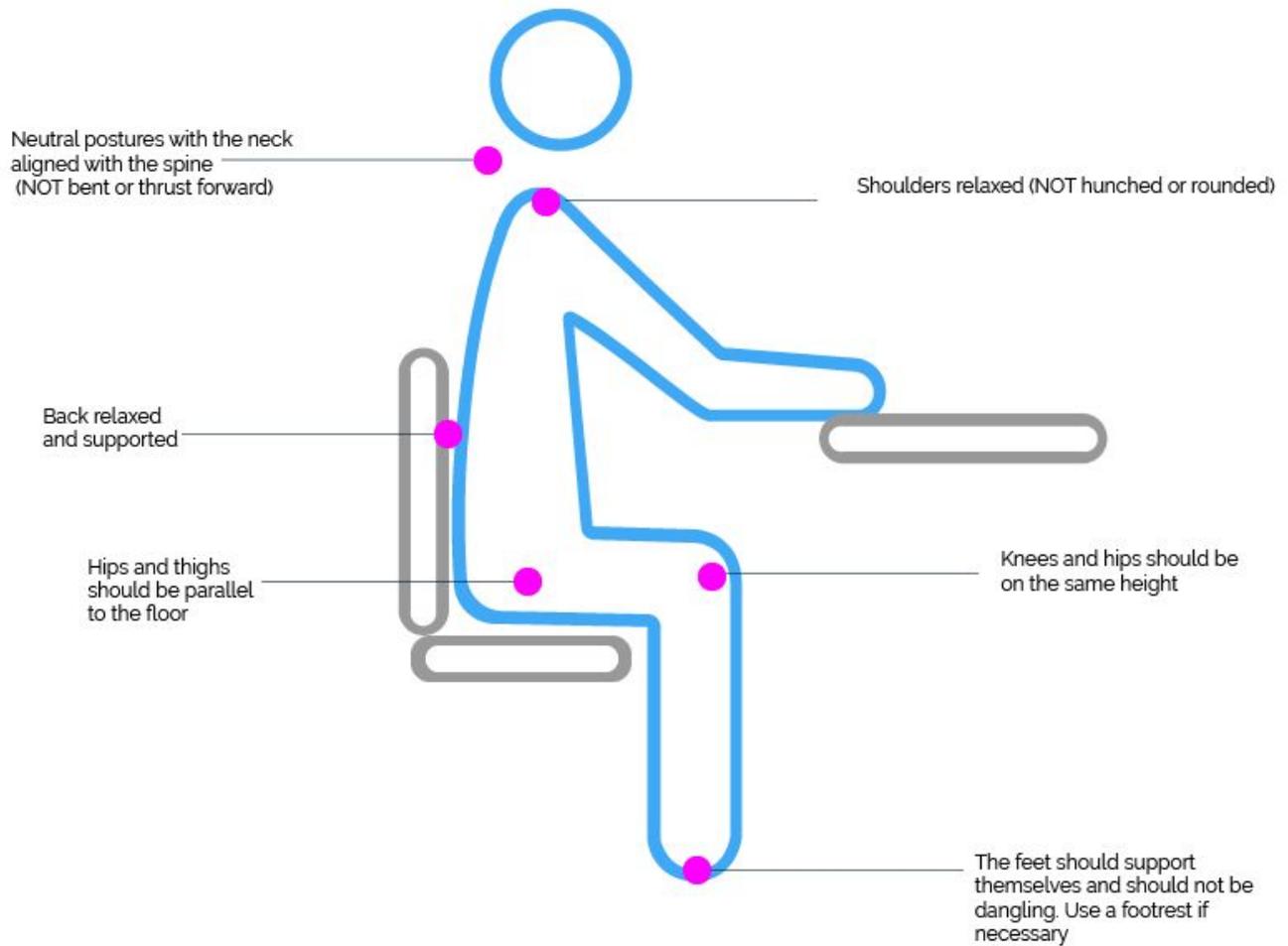


Take PoseRight for a test run

PoseRight will monitor how you position your body until May 10, 2019, 3:33 a.m. You can stop it at any time by closing this tab or by clicking [here](#).

How do I keep good posture?

¹⁵Laptop Ergonomics <https://uhs.berkeley.edu/sites/default/files/laptopergonomics.pdf>

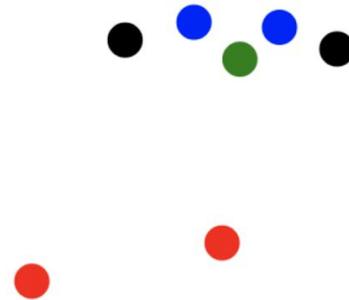


Key parts of good sitting posture

Tracking

Once the user starts using the PoseRight application, the algorithm observes the user's posture via webcam and decides if the posture is good, poor or uncertain. Instances of uncertain posture occur when a user is away from the screen or when the key points (eyes, nose, shoulder) cannot be determined.

Here's a real time review of your posture



The dots indicate key indicators of your body posture. Eyes are blue. Nose is green. Ears are black. The shoulders and neck are red.

GOOD

3

Instances of poor posture

9

Instances of good posture

0

Instances of uncertain posture

Reporting

The application observes posture which is then translated into a report to help the user analyse the time spent in poor posture, co-relate various activities during the day leading to or causing bad posture and then help them improve posture by continuous feedback.



PoseRight has detected a consistent slouch in the last one minute.

Example of a notification

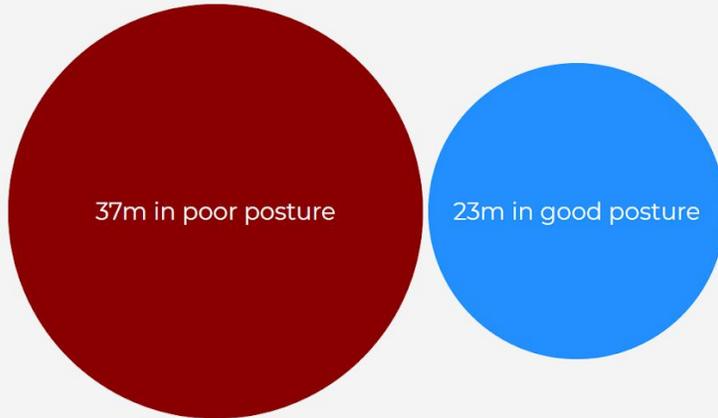
Many of our respondents indicated that they have a strong preference to being notified of poor posture positions i.e. if they are slouching for the last minute, they would want to be notified so that they can correct it.

There are two main visualizations that show posture information, as shown below. The first one captures a summary of the session i.e. overall, a user spent 23 minutes in poor posture cumulatively. The second visualization is an exploded version of the first visual and is meant to capture any trends in posture behavior.

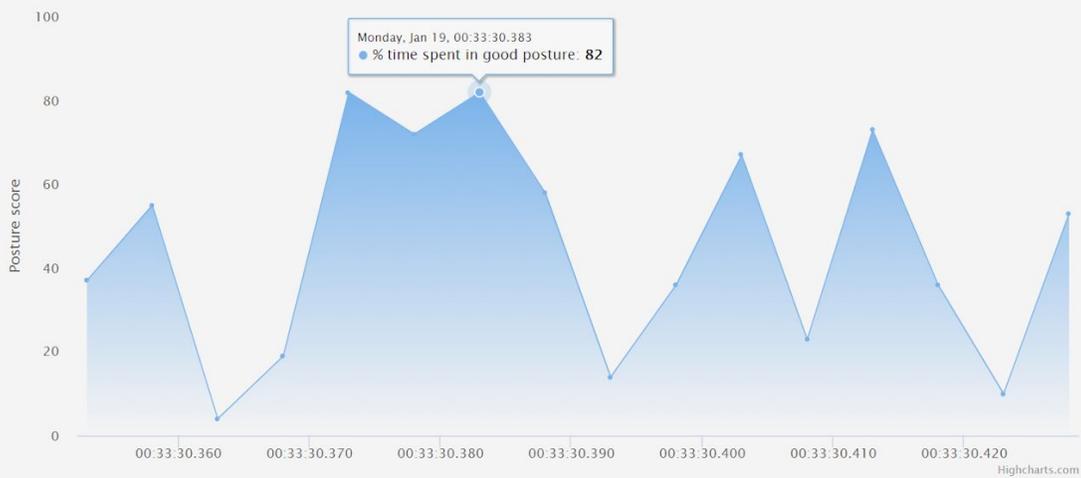


Eve's Report

In the last one hour, you spent:



60 TOTAL MINUTES SPENT



Development: Tech Stack

All our application development can be found in our Github repository.
<https://github.com/mevey/PoseRight>

django

PoseRight was developed using the Django which is a python-based free and open-source framework that enables developers to build database-driven web applications quickly. The Model-View-Controller architecture that it supports allowed us to separate front-end and backend concerns during development.

Django has a powerful template engine called Jinja that enabled us to use HTML and Javascript to deliver dynamic content. We leveraged webcam libraries to be able to turn the webcam on and off and at the same time take snapshots of our users as they worked.



We used MySQL as our data store for user session information, and results from our model which were used to prepare reports for our users. Django's Object-Relational-Mapper(ORM) allowed us to We chose an SQL database as opposed to a NoSQL database because the data we would manage was well-structured.

Here's a structure of the PoseRight database

Profile: Each user has a profile information saved. User have the option of starting a session without adding any information about themselves other than a name/nickname or logging in with their preferred Google Mail address.

- Name: user preferred name or nickname
- Image url: Link to Google Mail avatar that is used to personalize the experience with the application.
- Added: The date and time the user is first added into the session.

Session: A session is any period of time that PoseRight is running. The user has complete control on when it starts and stops.

- Profile: This is the foreign key that links a session with a user.
- Session: Each session has a unique key.
- Start: This variable store the exact timestamp of when the session begins.
- Minutes: This value indicated how long the session is expected to last

SnapShots: A snapshot is an image taken of the user in a moment in time.

- Profile: This is the foreign key that links a session with a user.
- Session: Each snapshot is linked to a session so that reporting can be
- Timestamp: this variable stores the exact time that a snapshot is taken.
- Output from model: The model determines if a snapshot holds poor or good posture and that is stored in this variable.
- Height and width: This stored the snapshot's height and width
- Nose, right shoulder, left shoulder, right eye, left eye, right ear, left ear and neck variables store the x and y coordinates of of the elements in 2D space.



OpenPose is the first open-source realtime system for multi-person 2D pose detection, including body, foot, hand, and facial keypoints. Another method is Object Detection using Haar feature-based cascade classifiers in OpenCV as proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. However, this detection method is not very accurate. As the first step in our product is to detect keypoints on the face and body, therefore we used OpenPose which is a deep learning library for pose detection trained on a larger dataset and much more accurate.

Limitations and Future Work

Perceived privacy

Perceived (state of) privacy refers to ‘an individual’s self-assessed state in which external agents have limited access to information about him or her’. Privacy concern and trust are two known proxies of perceived privacy. Privacy concern refers to individuals’ level of anxiety regarding a third party’s information practices. Trust in the current context is the degree to which consumers have faith and confidence in an organization’s privacy practices. Every day, an unfathomable amount of data flows through the Internet. This data contains information ranging from simple everyday conversation to complex and highly sensitive personal data and monetary transactions.

PoseRight provides the user complete authority and control to turn off the application when desired. Also it allows the user to use the application in chunks of time say 15 minutes or more. Also PoseRight does not store any image data when monitoring posture. It extracts the keypoints from the image and discards the image. However, users have expressed concerns about their privacy when using OpenPose and this therefore a limitation. Many users have expresses that they are willing to trade off between on the perceived privacy for a service to improve and correct their posture with PoseRight.

Improve model accuracy

We can improve our data collection process. We could gather data from experts, to help our model learn from the best posture practises. Also increasing the amount of data will help in learning from different types of data points and add regularization. This will help in improving the model performance in detecting good or poor posture with greater confidence.

Integrating with other applications

A natural extension to PoseRight is to plug in other daily management applications into it. For example we could integrate the calendar application into PoseRight to help users analyse different parts of the day better. If certain activity during the day is leading to poor posture, it can help to user identify such correlations and take necessary actions.

Posture Correction

Currently PoseRight helps in monitoring posture to provide binary feedback - good or poor. This can be extended to not only help the user know that is posture is wrong but also correct it. A personalized session can be created for an individual user to rectify the posture by superimposing correct posture skeleton on their 2D image. The users can align themselves to it and this will help build muscle memory and therefore help in posture improvement, to bring about a behavioural change.