

Health Tracker

An interactive dashboard to visualize personal health data

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ABSTRACT

Health and fitness tracking is quickly gaining more attention and the data collected can be of much importance, both to consumers and healthcare organizations. But most of these applications are mobile-based applications that can only be viewed on your phone-screens. Having personal interest in health and fitness, I wanted a way to analyse my daily activities to keep a track of my health and lifestyle. This motivated me to create a tool, that would allow users to plug-in their personal health data and get a holistic view of their activities and health-statistics in the form of an interactive dashboard. 'Health Tracker' is a tool that tracks, analyzes and displays key performance indicators (KPI) for health data, and displays these metrics in the form of cards, and allows interaction to manipulate data and gain new insights.

Index Terms: Data Visualization—Visualization—Visualization techniques—Dashboarding; Data Visualization—Visualization—Health Data Visualization

1 INTRODUCTION

Graduate life seems like an impossible balance between research, school and studying, that sometimes, one might easily loose track of what day it is or what one ate as their last meal! We get so lost in what we do, that we often neglect whats most precious to us - our health. According to a report by World Health Organization,

“Adults aged 1864 should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent combination of moderate- and vigorous- intensity activity”

As someone who is health conscious, it was imperative for me to get a sense of what my daily activities and health statistics looked like, to analyze and make some required changes in my lifestyle. This motivated me to create an interactive dashboard, that would allow users to plug-in their personal health data and get a holistic view of their activities and health-statistics. 'Health Tracker' is a web-based application that allows a user to track, analyze and display key health data information, mainly physical activities. This allows for viewing your personal health data on a larger screen, to allow better comparison between different, metrics, which is otherwise limited on many mobile-phone based applications due to smaller screen size and resolution restrictions. It follows a card layout on a dashboard, where each card shows a different metric, and has linked filters which can allow user to compare metrics for certain 'date' filters like - day, month or year.

2 RELATED WORK

Most of the health and fitness tracking applications are made for mobile phones that is limited to a small phone screen, and allows attention to only a specific metric or key information at a time. Nevertheless, these applications are highly refined and give in-depth insights and information regarding one's personal health data, acquired either through sensors on the device or other connected smart devices. Apple's *Health* is a health-informatics application which is supported by the HealthKit API, and was introduced in 2014 as a built-in application for the Apple Iphone (iOS 8 or later). It is a personalized health app that allows the user to organize and add personal health data, and also provides visualization of health data recorded on the Iphone, Apple Watch, AirPods and other third-part applications. The same health data from the HealthKit API was used to create the visualizations for 'Health Tracker' dashboard, which used data collected and exported from my Apple Iphone 8. Other applications like Apple's *Activity* and *HealthView* are popular applications which are available on the *AppStore* for iOS devices.

3 HEALTH TRACKER

'Health Tracker' uses a card layout for the dashboard, where individual cards show different metrics and health-data information in the form of interactive charts, scatter plots, and single value metrics. The data for the dashboard is from the HealthKit API which provides a central repository for health and fitness data on iPhone and Apple Watch. With the users permission, apps communicate with the HealthKit store to access and share this data.

The dashboard allows user interaction in the form of calendar and drop-down filters for day, month or year and in chart interactions such as box-select, text-on-hover and double-click-to-reset.

The 'Health Tracker' dashboard consists of the following components

3.1 Activity Summary

The *Summary* card gives a quick visual reference of daily activity recorded on your Apple Watch, using thee metrics - Stand, Move and Exercise. Each metric is shown in the form of a circular gauge, which is 'filled' based on your average value for that metric for a selected day, month or year. A user defined 'goal' is set for each metric, and when you complete each goal, the gauge is completely filled. The value for each metric is also shown in text in the center of the circle.

Each activity also has trend graphs in the form of a scatter plot and a spline, with the marker for current date, month or year highlighted with a darker color. This allows to see the trend of the activity for the past and future timestamps. For the 'day' filter, data points for +/- three days is shown.

3.2 Heart Monitor

The *Heart Monitor* card gives a visual of the heart rate; measured in *beats per minute*, (*bpm*), collected by the Apple Watch or a heart rate monitor, which allows you to see your heart rate patterns and variability for a particular date (and +/- three days), over a month or a year. The *Heart Monitor* card gives a visual of the heart rate data



Figure 1: Activity Summary

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The *Heart Monitor* card gives a visual of the heart rate data collected by the Apple Watch or a heart rate monitor, which allows you to see your heart rate patterns and variability for a particular date (and +/- three days), over a month or a year. The card also displays the *average heart rate* and *range* of heart rates for a particular time period and provides some additional information on heart rate on hovering over the heart icon at the top-right corner.

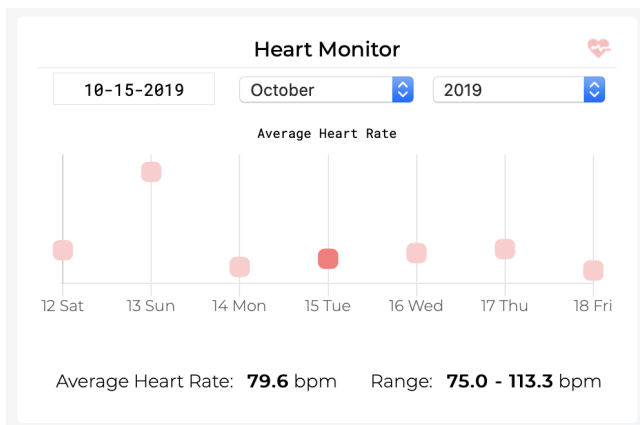


Figure 2: Heart Monitor

3.3 Daily Activity

The *Daily Activity* card displays metrics for daily activities like - **number of steps** taken, number of **flights climbed** (each flight of stairs is counted as approximately 10 feet (3 meters) of elevation gain (approximately 16 steps), **total walking + running distance**, and **active energy burned** (an estimate of energy burned over and above your resting energy, which includes activities like walking slowly, pushing your wheelchair, household chores and other exercises like biking or dancing). (TBD)

3.4 Workouts

The *Workouts* card visualizes outdoor workouts like *Hiking*, *Running* and indoor training such as *High Intensity Interval Training (HIIT)* data in the form of singular value metrics, for a particular date. It gives information like - **source** from where data was recorded, **duration** of the activity, **total distance** covered (incase of outdoor activities) and **total energy burned**, which is the sum of the total active energy and total resting energy for that exercise.



Figure 3: Workouts

3.5 Sleep Analysis

The *Sleep Analysis* card provides insight into your sleeping habits by showing your average **in-bed time** for a selected date, which reflects the time period you are lying in bed with the intention to sleep. This tracker can help you determine the amount of time you are in bed and asleep. The card also provides some additional information on sleep analysis and the in-bed time metric on hovering over the bed icon at the top-right corner.

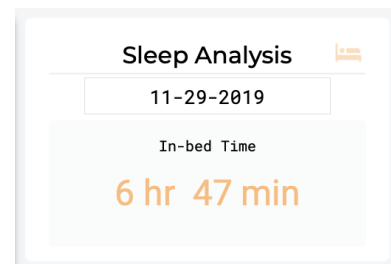


Figure 4: Sleep Analysis

3.6 Audio Exposure

The *Audio Exposure* card represents the volume of your headphone audio, measured in A-weighted decibels (db), for a selected date. This can be helpful to understand how long you've exposed to loud audio as this can affect your hearing. This data is collected either from your headphones, and are most accurate when using Apple or Beats headphones. The card also provides some additional information on audio level exposure and suitable levels of volume on hovering over the ear icon at the top-right corner.



Figure 5: Audio Exposure

4 FRAMEWORK

The basic layout and styling of this tool was done using HTML/CSS/JavaScript. D3.js was used to create the *gauge* visuals to display the three metrics in the activity summary section and Plotly.js Javascript Graphing Library was used to create the metric trends for *Move*, *Exercise* and *Stand*. The heart monitor chart was created using Chart.js library. Data was collected and pre-processed using Python3.

5 DATA

Data for this demo tool was acquired by using my personal health data exported from my Iphone using the HealthKit framework, and was further pre-processed using Python3 and Pandas library to create individual CSV files to be ingested by the tool for data of type -

- *activity* for Activity Summary card
- *record* for Heart Monitor, Sleep Analysis, Audio Exposure and Daily Activity cards
- *workout* for Workouts card

6 USER INTERACTIONS

'Health Tracker' is an interactive tool that allows the following interactions -

Filter by Calendar date User can filter data based on a particular date from the calendar, which only includes dates for which data is available. A range of dates is allowed for which data exists, and for measures like - Sleep Analysis, Audio Exposure and Workouts, only specific dates are "enabled" in the calendar which the user can select.

The calendar filter in the Summary card is also linked to the Heart Monitor, to display data for Activity metrics and average heart rate for a particular date.

Filter by Month and Year User can also view data for a particular month or year by choosing options from a drop-down list, which displays average metrics for that particular month. Similar to *filter by calendar*, only those months and years are available as list options, for which data is available.

Select Region on chart User can select a particular region of the chart for the Summary card metric trends, to zoom into a narrower window for interested data points. User can reset the window by double-clicking in that region.

Hover for tooltips The user can hover over specific data points to learn about the exact value of the metric. Cards like Heart Monitor, Sleep Analysis and Audio Exposure also contain icons on the top-right corner, which contains additional info about their respective measures and metrics, with data like tables and hyperlinks to external sources.

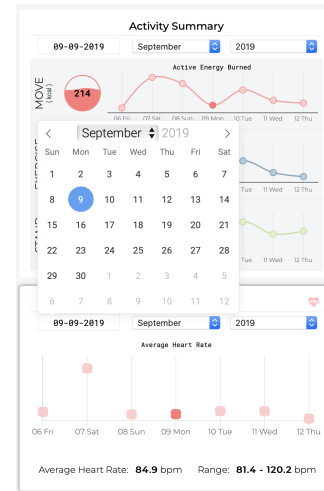


Figure 6: Filter by Calendar Date

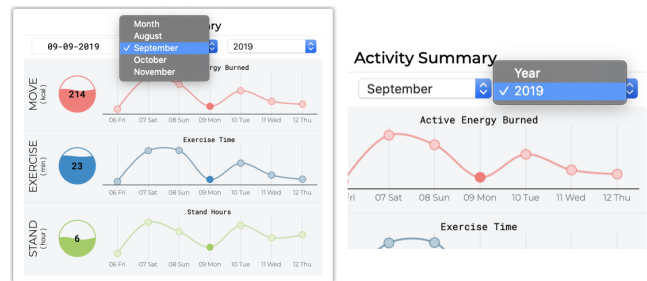


Figure 7: Filter by Month or Year

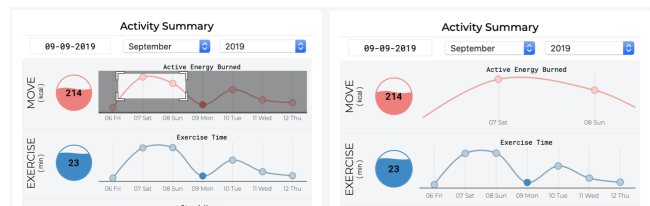


Figure 8: Select Region in Chart

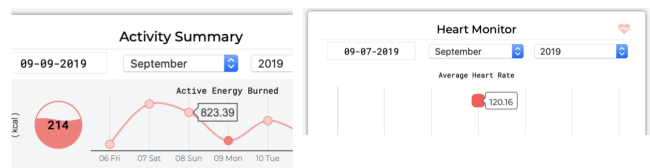


Figure 9: Data point value in tooltip on Hover



Figure 10: Additional information on hovering over card icon (heart, bed, ear)

7 DESIGN PRINCIPLES

The following design principles were taken into consideration while building this tool -

Unified theme and color palette was selected for data belonging to each activity metric - MOVE, EXERCISE and STAND, which follows Gestalt's Law of Similarity, and allows quick correlation and comparison.

Data linking was used allow comparison between different measures of activity metrics and heart rate count, to gauge if higher levels of heart rate were recorded for certain days of high activity or low activity.

Data annotations with tooltips and text labels were used to show data point values, metric names and units of measurement (kcal, min, hours, dbA).

Balanced design using a card layout, where each card shows data for a particular metric, with consistent design and formatting.

Emphasis and focus to key metrics and information was shown with animations (activity summary gauges), color hues (scatter charts and line graphs), text color and size (single value metrics) and slow fade-out transitions for additional information tooltips, to allow the user the process the information more effectively.

Variety of data by showing different metrics in the form of dashboard, which allows a the user to get a holistic view and sense of the data.

8 CONCLUSION AND FUTURE WORK

The goal of this data visualization tool was to allow the user to get an overall sense of his health and activity data, available as a 'plug-and-play' application to visualize data on the go. Health Tracker allows you to see trends and patterns in your health data and also learn about specific data metrics for a particular time period or date. This tool is still a work-in-progress and will include more enhancements and updates in the future. As part of future work, i wish to implemet the following -

- Create more interactive charts or visualizations for *Workouts* and *Daily Activity* sections.
- Create an SSO login with AppleID to allow user to upload personal health data on-the-go using fingerprint or Multi-factor authentication.
- Make the project code open-source and publish completed tool on GitHub which would be available for a free download.

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