

# Wearable - Fitbit Flex 2

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## Overview

Wearable devices organize “your life” through one or more sensors that observe data from your body and/or environment and process the data with potential feedback provided by yourself or an additional agent (it could be another person or computational agent). Although structured and fine-grain data is initially consumed by the wearable’s sensors, the particular data processing that occurs depends on the insights the wearable and its companion apps are generating at a given time. In the case of the Fitbit Flex 2, motion data from the sensors is organized in addition to event data that trigger notifications (such as phone calls, wake-up alarms, etc.). Once sensor data is available, the Fitbit app acts as a computational agent to organize the data in collaboration with other computational agents in the app itself and in Fitbit’s servers. This case study will focus primarily on the organizing system that starts with collecting a user’s motion data and then subsequently powering the user’s interactions with the Fitbit app.

**What is being organized?** The Flex organizes your life activities, including, but not limited to walking, exercise, sleep, and electronic notifications. Although an activity such as walking may require organizing information about distance walked, an activity like sleep may require organizing information in an entirely

different way. At its core, however, the information being organized is purely data recorded from Flex's device sensor, a 3-axis accelerometer, which precisely records movements of the user. The raw data itself is composed of data points that represent motion of the user over time and space. The data can be translated into information characterizing any activity the user performs while wearing their Flex and the data can also leverage other data sources to further enrich its understanding of the user's behavior. For example, the Flex uses its knowledge of the user's height and gender to more accurately calculate the distance traveled. In terms of electronic information, Flex also organizes information from user activities such as messaging, phone calls, wake-up alarms, etc. to create Flex notifications to direct the user's attention.

**Why is it being organized?** The personal nature of Flex's information containing a diary of its user's movements enables the device to create a picture of the user's activities. Since these calculations of user behavior are carried out in an automated fashion with minimal user input required, the activity information being organized has utility in any area where tracking daily activity may be useful. The information is organized so users have sufficient visibility into their activity for goal-setting purposes, for gamification purposes, for health or diet applications where the data is relevant, and for assorted activities that are made possible through the data generated by Flex. The main theme is that once data is collected, applications can be built on top of the data to benefit the user. In terms of built-in features in the Fitbit app, users can set sleep and step goals, users can challenge their friends, users can share their information with a healthcare provider for potential cost-savings, and more. In terms of notifications, Flex can also notify users via haptic feedback using its vibration sensor to draw user

attention in the event of phone calls and other events that the user has configured Flex for. The data serves as a basis to unlock opportunities for applications provided by Fitbit and for applications created by developers through Fitbit's API. It is also worth noting that although many of Flex's capabilities are health and wellness related, Fitbit's Terms of Service explicitly states that "The accuracy of the data collected and presented through the Fitbit Service is not intended to match that of medical devices or scientific measurement devices." Therefore, Fitbit does not have the goal of directly serving as a medical device.

**How much is it being organized?** As discussed, data is collected at sensor-level precision that is then translated to yield meaningful user behavior information. The amount of sensory data that is organized and reorganized depends on the Fitbit applications enabled at any given time. For example, sensor data is organized in a unique manner for tracking distances the user has walked versus how long the user has been in a sedentary position. In terms of storage granularity of saved data at a given time, Flex is capable of storing 7 days of minute by minute motion data as well as daily totals for the past 30 days. Another note is that Flex motion data for a given time period is not necessarily limited to being organized only a single time. Motion data can be reanalyzed and organized to yield more detailed insights with new future knowledge as well. The amount of organization operates independently in two distinct areas: organization for insight generation and organization for interaction. Organization for insight generation refers to organization of sensor-level data to synthesize information about a user's behaviors. Organization for interactions is a layer of organization that happens on top of the insight generation. This organization is an additional layer of processing that sifts through insights with the purpose of planning out

how to communicate the large amount of Flex data to users in a straightforward way. An example of this is the 5 LEDs and vibration motor that Flex relies on to communicate information to users directly through the Flex itself without the user looking at a Fitbit companion app on a phone, computer, etc. Fitbit must organize notification information, whether it is related to reaching a walking goal or an incoming phone call, to communicate through its limited interaction medium of vibrations and LED lights.

**When is it being organized?** Since Flex's data collection pertains exclusively to motion data from a user's body, Flex is constantly organizing the motion information of the user as long as it is charged and on the user's body. In regards to the motion data being organized and distilled into insights, the information is being organized at a few different times: on-sync (when motion data is synced to Flex's companion app), on user interaction (when a user requests specific information that needs to be computed from or travel down from Fitbit's servers), and on-demand (when Fitbit receives data such as a phone call on the user's iPhone that triggers an event response).

**How or by whom is it being organized?** Flex data is organized by computational agents created by Fitbit and Fitbit's service partners. All the data produced or collected by Flex and Fitbit has an imposed structure on it. This results in the ability of computational agents created by Fitbit and other developers to organize the information in a scalable and efficient manner. The constrained structure of the data also grants the ability to seamlessly update these computational agents at any given time.

**Where is it being organized?** The data is being organized on the Flex device itself, in Fitbit's companion app, and in servers managed by Fitbit and its partners. The form factor of the Flex allows for its use across the body in a variety of clothing accessories. The data only encounters minor organization on the device itself due to its limited computational power and storage space, but after syncing to the Fitbit companion app via Bluetooth Low Energy technology, organization can then take place on a much greater scale. Organization occurs in Fitbit's companion app, but since the app also has connectivity to servers via the Internet, unrestrained organization of significant scale and speed is readily available to the app.

**Sources:**

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