Promoting Health and Well-Being of Workers through Automatic Sensing and Goal Setting

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Abstract

In our busy schedule, we often tend to neglect our health and well-being as we focus more to expedite our income. This is commonly observed in cases of non-traditional work where people have greater flexibility on deciding whether or not to accept a job unlike traditional jobs. In addition, this is observed in cases of corporate world where workers tend to sit at their workstation for long hours which is often referred as sedentary behavior. Workers often fail to understand the relationship between health–related issues and work–related decisions, such as scheduling to take proper rest and sleep. In order to combat the issue of long working hours and encourage physical mobility, workers can be made aware of their daily activities through the means of sensing devices, i.e., *Fitbit smartwatch*. However, the main concern is how to make an efficient use of the sensing data. To address this issue, I have developed a *web application prototype* to help workers make aware of their well-being and take informed decisions through the means of goal setting.

Author Keywords

Well-being; Fitbit; Heartbeat; Steps; Calories; Miles; Sharing Data; Goals

Introduction

It is important for workers to maintain an awareness of their well-being and make work-related decisions to achieve work-life balance who work for long hours. But to further their cause of earning money, people have now started working for longer hours, i.e., more than 40 hours a week. There is a big misconception about well-being that it solely refers to the absence of disease or illness. However, it refers to a range of issues associated with physical, mental, emotional, and social health, all of which could eventually affect safety, employability, satisfaction and performance at work. The kind of work ethics which involves long working hours is observed in cases of non-traditional work where people have greater flexibility on deciding whether or not to accept a job unlike the traditional ones where the number of work hours and income is fixed. But traditional workers also end up working for long hours due to huge workload.

The workers are unaware of their well-being and they need to understand the importance of work-life balance and should maintain a schedule to take rest and sleep. Unfortunately, many of the signals pertaining to health and well-being are generally overlooked or disregarded. In some cases, it can be proved to be fatal. For example, it's dangerous for the passengers of a vehicle, if the driver falls asleep while driving as it could lead to serious accident. Nowadays, such accidents are happening more frequently due to reasons mentioned earlier.

Thus, it's high time, a solution be devised to cap the long working hours for flexible works and provide a mechanism that would enable workers to track their personal well-being when high workload could be enviable. Therefore, I have developed a web application prototype that would help workers make aware of their personal well-being through sensing data. The application then allows workers to connect with a potential supporter who can help them set daily goals on the basis of the sensed data. In return, the workers can also set daily goals for their supporters. At the end of each day, the workers can rate (on a scale of 5) their supporter to reward them for their contribution. The application retrieves a worker's sensing data from their *Fitbit device,* such as the number of steps taken, miles walked, miles biked, calories burnt and hourly heart rate. It's possible because of the *Fitbit* Web API that helps to access real time data from *Fitbit* activity trackers.

Background

In the recent years, more and more people have been seeking income via gig apps like Uber and Lyft. According to the Gig Economy Data Hub, a research collaboration between the Aspen Institute's Future of Work Initiative and Cornell University's ILR school, it has been estimated that more than one in 10 workers rely at least somewhat on these kinds of companies for their income. In addition to that, sitting for long hours takes a toll on the well-being of the workers.

According to a report by the Human Impact Partners Association, people who sit for long hours in a day encounter pain in their lower extremities, their back, and throughout their whole bodies [1]. Studies of corporate workers have found that the prolonged sitting limits overall physical activity and creates musculoskeletal disorders and chronic pain, including lower back and knee pain [2]. Prolonged sitting also leads to increased risk of diabetes, heart disease, cancer, anxiety and depression, as well as physical effects like shoulder pain.

In case of industrial environments, frequent physical movement reduces accidents and physical discomfort [3] and in office environments short breaks help workers to avoid repetitive strain injury, muscle fatigue, and excessive sedentary behavior [4,5]. Even short breaks have been shown to offer substantial benefits [6]. Workers can take mental breaks from focused work so they can return both physically and mentally refreshed and be "ready to work" [7].

However, goal setting has been shown to be an effective strategy for changing behavior; therefore, employing goal setting in persuasive technologies could be an effective way to encourage behavior change [8]**.** For this, there are certain research questions that needs to be addressed.

RQ 1: What goals needs to be set?

RQ 2: How to set effective and efficient goals?

RQ 3: What should be the duration of the goals?

Brainstorming Session

To investigate the goal setting practices and difficulties encountered by workers, I conducted a brainstorming session with the Human Computer Interaction Lab members. In total, there were 9 participants equally divided into three groups. They were asked to discuss and put down points in their respective groups for the brainstorming question which is as follows:

Ques: What are the problems that might be encountered by workers while setting goals?

Each group was given 10 minutes to ponder over the question collectively and state the problems. At the end of the session, I combined and divided the responses into two clusters. The first cluster highlights the issue of lack of motivation that workers encounter while setting goals. Whereas, the second cluster highlights the need of external help for setting goals.

Cluster 1

While setting goals, workers are:

- ***a.*** *Not sure about whether their regular routine will permit them to achieve this.*
- ***b.*** *Unable to divide the big and abstract goal into smaller and actionable ones*
- ***c.*** *Not sure about reasonable expectations (can I lose 20 pounds in one week?)*
- ***d.*** *Not aware of difficulty to keep up. Don't know how to set goals balancing workload and training load.*
- ***e.*** *Always setting goals over their ability to achieve and sometimes set inappropriate goals too ambitious*
- ***f.*** *Overestimating the time efficiency and personal capability of completing the goal*
- ***g.*** *Setting goals that are difficult to achieve (e.g., too many steps to take)*
- ***h.*** *Very energetic and excited for the first few days, but fail to stick to the plan later*
- ***i.*** *Lacking motivation to set a goal*
- ***j.*** *Not spending proper amount of time for the healthy activities for a goal*

Cluster 2

While setting goals, workers:

- ***a.*** *Can't find the right apps/approaches to put my goals. Apps are all ugly..ugly..ugly..*

b. *Are having the mindset that we can't achieve personal goals without persuasion*

c. *lack background and expert knowledge for practical goals like how many times one should exercise each week*

d. *Don't know how to make general goals more specific and practical*

e. *Don't have the expertise of knowing what kinds of sub-goals to set, in order to achieve the final goal (e.g., the final goal is to lose 10 kg, but what to do, and for how long?)*

f. *Are not knowing how to set the priority of different goals*

After analyzing the above responses, it was concluded that the workers need some kind of motivation and a supporter whom they can rely upon for setting goals.

Goal Setting

For the past many years, goal setting has proven to be an effective methodology to achieve tough targets. In fact, it is a theoretically grounded, empirically supported, and one of the most popular behavior change strategies employed by activity trackers– individuals set daily activity goals (e.g., 10,000 steps) and continuous feedback on their performance is provided by the tracker [10]**.**

One of the main advantages of goal setting is that it helps to set out once intentions and desires to achieve targets. It also ensures effective use of time which is critical in case of workers who are concerned about work-life balance. According to the Goal Setting Theory (GST), goals that are self-set, important, difficult, attainable, specific and proximal, tend to be effective in motivating individuals to achieve them [10].

For workers, it's important that the goals are achievable and relevant. In the past few years, popular activity trackers like the Fitbit smartwatch, Apple Watch Nike and Garmin smartwatch have attracted large numbers of consumers primarily due to real time sensing data and ability to set goals. However, there are still some gaps associated with goal setting in activity trackers that need to be addressed.

In the Fitbit ecosystem, one can set the target step count, calories to be burned, sleep count, weight goals and water intake as shown in *Figure 1* [12].

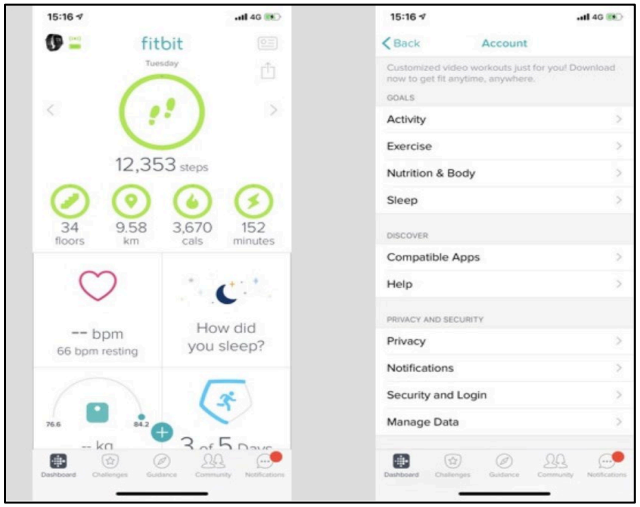

Figure 1: Fitbit Goals

Similarly, users can also adjust their training goals in Garmin smartwatch [13]. In addition to that, users can also set daily, weekly and monthly goals as shown in *Figure 2*. However, it's highly probable that users might

set unachievable targets due to the lack of knowledge as these devices don't restrict user control to set unrealistic goals.

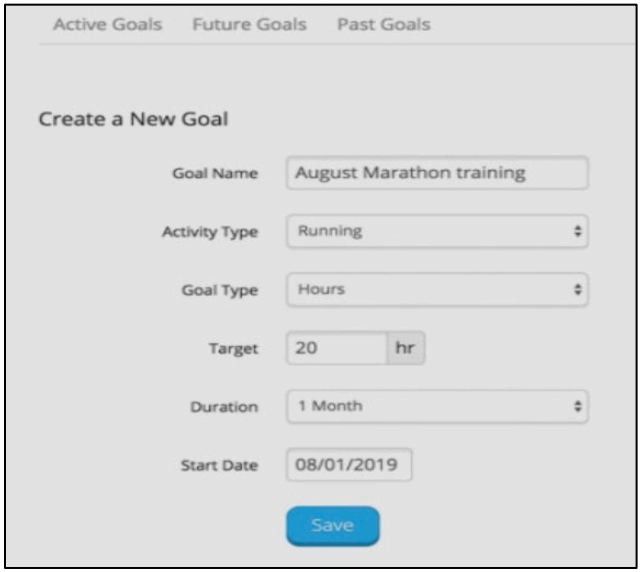

Figure 2: Garmin Connect Goal Setting

Whereas, the Apple Nike Watch gives users three goals: standing, moving and exercise which are displayed in the form of rings. Of the three activity rings in Apple Nike Watch, two are the same for everyone: standing and exercise [14]. Users can only change the Move ring where they can alter target calories count as shown in *Figure 3*. To overcome the issues mentioned earlier, my prototype application allows a supporter to set goals from a predefined list of activities that would have a positive impact on the worker's sensing data. Moreover, to assess the progress of a worker, the application directs a supporter to revise goals every day.

Figure 3: Apple Nike Move Goal

This would ensure effective impact on the well-being of workers since they are in a constant check by their supporter. Table-1 lists the activities recommended to ensure well-being of workers [15,16,17,18,19,20]. As stated earlier, these activities are available in the application which can be chosen by a supporter to set goals for workers.

Activities	Range (per Day)
Jogging	1 mile, 2 miles, 3 miles
Walking	1.5 miles, 2.5 miles
Biking	5 miles, 6 miles, 7 miles
Planks	10 sec, 20 sec, 30 sec
Push ups	10 reps, 15 reps, 20 reps
Squats	36 reps, 39 reps, 42 reps, 45 reps

Table 1: List of daily activities with durations

It might be a case that the supporter is also not aware of their health and well-being. In fact, it would be beneficial for them to have a supporter who could help them set goals. Therefore, in order to establish and strengthen trust between workers and their supporter, the application also allows the workers to play the role of goal setter for their supporter.

Sharing Sensing Data

The ease of sharing real time sensing data by the activity trackers with friends and family has been a critical factor to improve one's health and well-being. However, fitness tracker users require a greater awareness of the collection, ownership, storage, and sharing practices related to the tracking of their data [11]. According to the official documentation of Fitbit smartwatch, users can share their personal information such as date of birth, gender, height and weight with their friends. They can also share their sensing data such as number of steps, heart rate, calorie count, sleep count, water and food intake for the past 30 days. But what's most concerning is that users can share their GPS map after completing a run as shown in *Figure 4*.

Moreover, according to the Apple Nike Watch User Guide, not only sensing and personal data, users can also share their real time GPS location with friends as shown in *Figure 5*. Although users have control over sharing their data, but these devices still pose threat to users' safety. In order to address this issue, my application would allow a worker to share specific sensing data such as number of steps taken, calories burned, hourly heart rate, miles walked and biked for the past 24 hours. Apart from that, the worker's personal information such as weight, height and gender would be visible to the supporter.

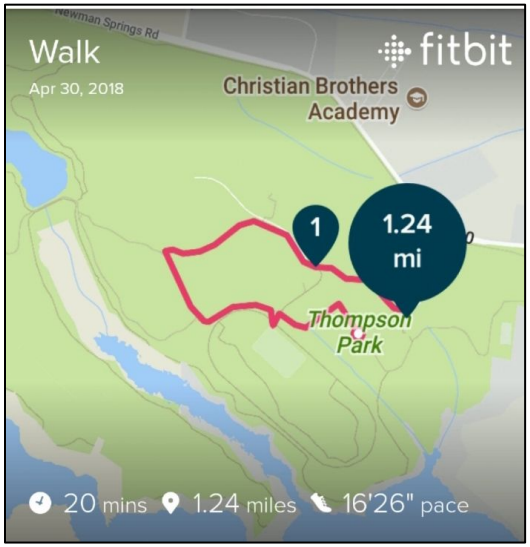

Figure 4: Fitbit GPS Map

Figure 5: Sharing Live Location on Apple Nike Watch

Virtual Rewards

Since the advent of the online forums, people have been actively engaged in sharing knowledge online. Most importantly, they want to be recognized and earn reputation for their contributions. To enhance user participation and sustain collaboration, it's imperative to motivate users. Virtual rewards in the form of point's badges, levels and status have been an incentive to induce voluntary contributions to the knowledge communities [9].

Similarly, this web application prototype allows workers to rate their supporters (on a scale of 5) for setting daily goals. The average of the cumulative sum of the ratings for the number of days, a user served as a supporter is the final rating at the end of n^{th} day. This rating is detrimental in a way that it reflects reputation of a user to serve as a potential supporter.

Design Implementation

The primary functionality of this web application is to retrieve a workers' *Fitbit* sensing data every 24 hours. These include number of steps, calories burned, hourly heart rate, miles walked and biked. The user interface of the application has been built using a JavaScript library called *React* since it allows to create reusable UI components. On the other hand, I have used *Node.js* to access *Fitbit Web API* and store the *JSON documents* in *MongoDB* to support scalability. This web application prototype consists of four components which can be accessed using the Navigation bar as shown in *Figure 6*.

Figure 6: Navigation bar

The navigation bar allows workers to choose from five tabs, i.e., Getting Started, My Info, My Goals, Peer Goals, and Share Data. Each component has been further discussed below.

a. Getting Started

It's important that the workers are familiarized with the functionality of the application. This tab provides user with a walkthrough of the application with the help of a vertical stepper consisting of four steps. The user can go through each step at a time. A step states the name of a tab and the various actions a user can perform as shown in *Figure 7*.

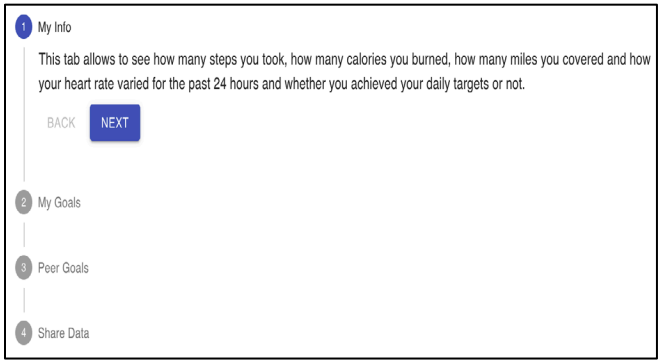

Figure 7. Stepper

b. My Info

This tab provides user with their *Fitbit* sensing data, i.e., graphical representation of the hourly heart rate, circular progressive bars for number of steps, miles walked and biked, and calories burnt for the previous day as shown in *Figure 8, 9, 10, 11 and 12*. Along with that, users can view their personal information such as Name, Sex, Weight (lb), Height (cm) and Rating. However, only the

user has the right to change all parameters except Rating as shown in *Figure 13*.

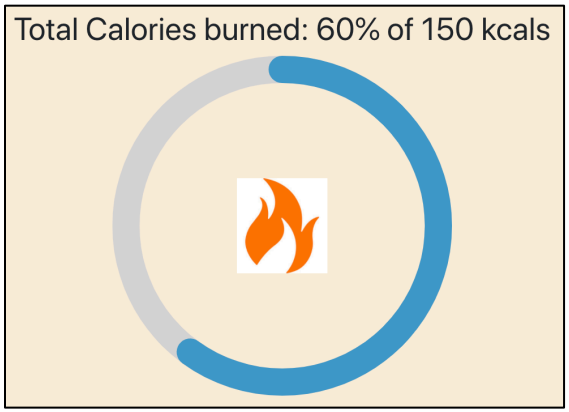

Figure 8: Circular Progressive bar of Calories burnt

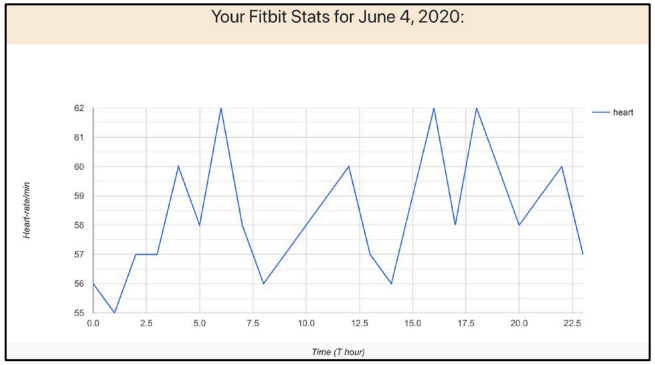

Figure 9: Graphical representation of Heart Rate

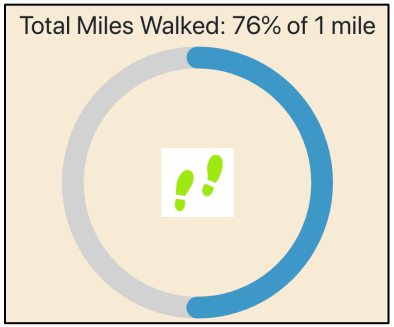

Figure 10: Circular Progressive Bar of Miles Walked

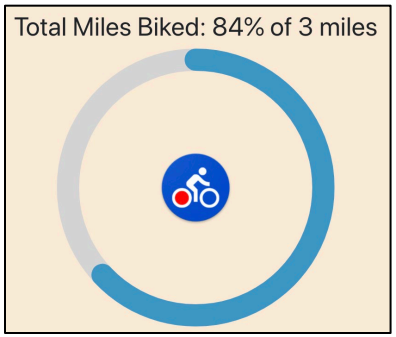

Figure 11: Circular Progressive Bar of Miles Biked

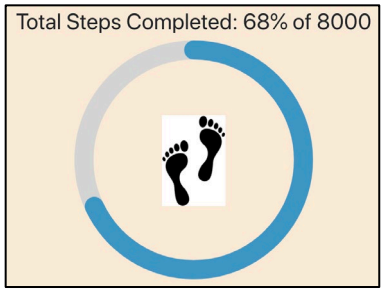

Figure 12: Circular Progressive Bar of Steps taken

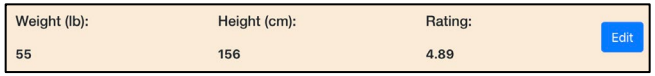

Figure 13: Users Right for change of parameters

c. My Goals

This tab lets a worker know the number of steps to be taken, calories (kcal) to be burnt and miles to be achieved till the end of the day. It also lists down the activities along with its duration in a tabular format to be undertaken by the worker in the next 24 hours. These targets can only be set and controlled by the supporter. However, the worker can change the status of an activity from "*In Progress*" to "*Completed*" by clicking on the *Edit button*. As shown in *Figure 14,* the worker can also reward their supporter for their contribution by rating them on a scale of 5.

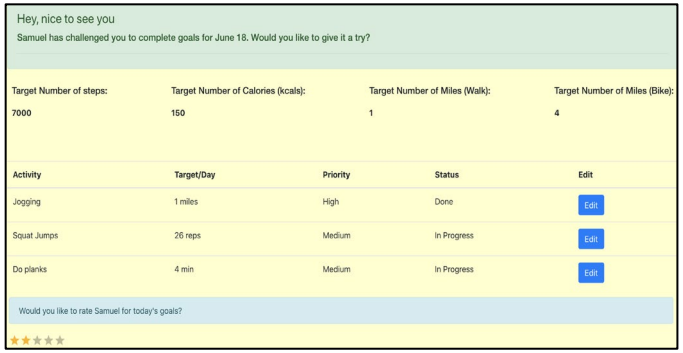

Figure 14: Goals set by supporter

d. Peer Goals

This tab lets a worker view their supporter's *Fitbit* sensing data for the previous day. On the basis of the data, the worker can update target number of steps to be taken, calories (kcal) to be burnt and miles to be achieved for the current day as shown in *Figure 15*. Apart from that, the worker can set the daily goals for the supporter by clicking on *Add Activity* button and choosing an activity along with its duration from the dropdown list. The activity is eventually appended to the table which lists the goals. However, the supporter can also change the status of an activity from "*In Progress*" to "*Completed*" by clicking on the *Edit* button.

Figure 15: Goals set by worker

e. Share Data

At any point of time, if workers wish to change their supporter, they can do in this tab as shown in *Figure 16*. The tab lists potential supporters available starting with the one having the highest rating and so on. Upon selecting one of the supporters, the *Email Address* field is populated with the corresponding email id. They can overwrite the predefined message in the *Message* field and click on the *Submit* button which sends an invitation URL to the potential supporter which would let the latter view the workers' *Fitbit* sensing data.

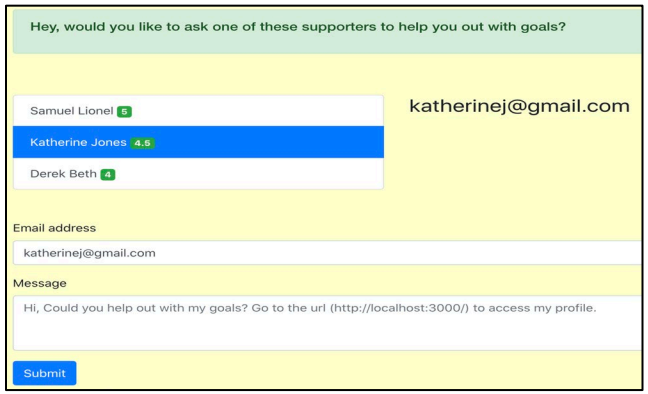

Figure 16: Option for workers to change supporter

Future Work

Once the goals are set by the supporter, the workers might defy if they are unrealistic to attain. They would want to come to a consensus with their supporters to alter daily activities. In future, I would like to embed a mechanism in this web application to help workers negotiate with their supporter to set duration for activities. Apart from that, users might object sharing their sensing and personal data even if a high rating is attributed to the potential supporter. They might want to have more control over sharing specific data. Hence, future work would also aim to address privacy concerns of managing and sharing users' personal and sensing data and to perform usability testing with a sample set of users.

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