

A Survey of Use and Adoption of Activity Trackers and proposed modifications to develop a Health Monitoring Device for Aged adults¹

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Abstract

Wearable devices tell more than just the time today. Such devices, which leverage the concept of the Internet of Things are being widely used by a lot of people. As of now, they are primarily being used for understanding trends in the daily activity of oneself. The following verses elaborate upon the most common wearable devices (primarily activity trackers) available in the market, their use and adoption, their shortcomings, and the proposal of a wearable device which can be customized for an individual with the primary use of monitoring the health of aged people.

Keywords: Activity; tracker; health monitoring; challenges; wearable

INTRODUCTION

The majority of the Indian population comprises the youth, with statistics saying that more than 50% of the population is under the mere age of 25 [1]. The implication of this scenario is that in the coming years, we'll have huge numbers of ageing people in the country. The present youth follows a largely sedentary lifestyle, since most of them have desk jobs. However, even though the previous fact still largely prevails, the rising awareness about fitness of late has been catching up with many and motivating them to take their fitness in their own hands. One of the results of this trend is the use of activity trackers. There are various aspects associated with them, such as the awareness about them amongst people, their use and how people are adapting to them and how it influences people. Various studies regarding the same have been conducted to understand each of these aspects better. Along with exploring these, the relevance of use of such activity trackers for the older population will also be elaborated. By the year 2030, older persons are expected to account for more than 25% of the population [2]. The previous generation was young at the time of the IT industry boom, and thus was part of the shift of jobs from various forms of physical labor based jobs to desk jobs but didn't have the kind of fitness related knowledge as most youth do today. Thus, this particular generation is at a greater risk of diseases in general and cardiovascular diseases in

particular. Although advancements in the medical field have enabled increased life expectancy, the physical presence of a physician is neither inexpensive nor always feasible. Therefore, it's only sensible we look into the aspects of technology which could benefit this part of the population by contributing to the monitoring of their health. Development of a low-cost alternative for health monitoring on a daily basis is affordable as well as feasible and would equip technology to proactively adapt to an ageing and ever-increasing population where the physical presence of a physician is not always possible or warranted.

EXISTING PRODUCTS

Many tech companies, small and big, have released a fitness tracker of their own. Since they belong to different price brackets, the features offered by each vary. In India, the cost starts from usually ₹999 and can go up to ₹32,000. The common features offered by generic activity trackers include showing the time, counting of steps, the distance walked, and calories burned. The advanced and expensive trackers offer additional functionalities such as graphical representations of daily activities, motivation to achieve an individual's goals, statistics pertaining to how the individual performed compared to other users, functions similar to a smart phone et al.

Reference [3] illustrates the results of a study conducted to find out the most preferred activity tracker out of the ones currently available in the market. Four devices – the Fitbit Flex, Withings Pulse, Misfit Shine and Jawbone were judged on the basis of various parameters deemed important by the users like user satisfaction, accuracy of the data collected, user interface used to display the data that is collected and user friendliness. The users found the Withings Pulse to be the best of all, however the real point of consideration is that the study has enabled find what the users really want. The users preferred devices which:

- Could display data on its own and did not require a smart phone.
- Could track stair climbing as a physical activity.

¹ A study about existing trackers, their use and adoption, particularly amongst the elderly and proposal for further improvement to promote better benefits and adoption amongst adults.

- Could be accurate for indoor activity measurement as well.

However, the study did not take into account varied users. There were 6 men and only 1 woman and all were of a similar age.

Reference [4] conducted a study to find out the reliability of fitness trackers. It was found that such devices often overestimated the number of steps and underestimated the sleep time or calories burned. It also concludes that the interdependence of most popular activity trackers with a smart phone, especially for the number of steps was very high. Since we know from the results of [3] that high reliability and less interdependence are features the users want, it is less likely that users skeptical of technology would turn to these. Older adults are likely to fall into this group.

In spite of these shortcomings, activity trackers are of particular interest to researchers in the field of human physiology due to their ability to measure human activity in real life conditions opposed to laboratory data gathered in conventional experiments. Also, they are already widely used by consumers, this makes it easier to examine certain changes which could be used to predict outcomes regarding an individual's health [5]. Also, the outcomes are considerable in nature due to strong correlation between data collected by the activity trackers and research grade devices. Fitbit One, Fitbit Zip and Withings Pulse were found to be the best performing devices [6]. However, the correlation results seem to contradict with the results of [4], unless research grade devices have the same shortcomings as well. Another study concluded that there were various issues related to data accuracy – data collection, which may result in inaccurate data due to user related issues like lack of time or lack of motivation or due to reliance on subjective estimation [7]. Overall, various studies have been conducted which have helped us understand the role of existing products.

USE AND ADOPTION

Social class, age and even the type of athlete acted as a limiting factor when it came to use of a fitness tracker [8]. Most of the users of such smart devices are younger and considerably affluent individuals with an inclination towards fitness. The middle and lower class perceive it as a luxury and even if they could afford it, they might not have the time for the same since most people belonging to the middle or lower-class work multiple jobs. When it comes to adoption among older individuals, there are certain challenges involved which hinder their usage of such devices. The most obvious challenge is the lack of initiation. Most of the older users are apprehensive when it comes to new technology and it also takes time for them to understand how something works. For the uninitiated, this itself might be a huge roadblock which would cause them to not use such a system [9]. Further, older people might already be suffering from health issues such as degenerative arthritis which may not allow them to take up any form of strenuous physical exercise. This defeats the purpose of an activity tracker and renders its motivation providing tools meaningless. Only athletes who walked or ran used such trackers. Athletes who swam could not use it since the tracker would be useless

in water. Athletes who performed other type of activities such as cross training, weightlifting or boxing found that activity trackers were not very beneficial for them.

Gender differences also play a role in the use and adoption patterns. It was found that women didn't warm up to fitness trackers as much as the men due to their concerns that it wasn't aesthetic enough or did not go well with their outfit [10]. Also, women's clothing often lacks pockets so it was difficult to carry it around in case they didn't wish to wear it.

The sizing of the device played a role in use too. If the device was too small, users could often forget to wear it. On the other hand, if it was too bulky, users would find it inconvenient to use.

PROPOSED MODIFICATIONS TO DEVELOP A HEALTH MONITORING SYSTEM

There is no dearth of activity trackers aimed at the youth. However, since there is a considerable amount of ageing population, shifting the target audience of such devices to the older population would require certain changes. The proposed wearable aid works on similar fundamental principles as the existing activity trackers. It would make use of sensors in combination with a microcontroller to achieve its primary functions i.e. sensing when is the user active. When we say active, we mean that the person is achieving some displacement. The sensors used are an accelerometer which tracks human activity, and a pulse rate sensor which monitors the human pulse. This data is passed to the microcontroller and smoothed out using a low pass filter. The microcontroller further processes it and thus, classifies the result as normal or an anomaly. The processing involves dynamically computing a normal value over a training period, taking into account the history of all readings. The proposed wearable aid aims to quantitatively measure human activity and also, specifically cardiovascular health and accumulates data over a training period. This data acts as the knowledge database, which helps in further computations. Thus, any abnormality can be reported by the aid to the person concerned. Due to the knowledge database accumulated by the device, periods of usual high activity which may be a result of normal exercise, et al can be negated. This results in a much lower rate of false alarms. Thus, it only reports an anomaly when there truly is one, by negating timings when the user may simply be exercising. The Wearable aid will monitor users 24 hours a day. Patients with serious illness can wear them at home, and it can notify the hospital or person concerned of any bad signs. In case of an anomaly, it is reported to the user's phone via Wi-Fi or Bluetooth using a Wi-Fi shield or Bluetooth module.

A sample case of an anomaly could be as follows – the pulse rate is outside the normal limits, however, there is no accelerometer reading i.e. the person is not actively moving. This would indicate rising pulse rate even during inactivity. Further, a diagnosis can also be provided based on the pulse rate trend. For instance, if the heart rate is not fairly steady but is not following a particular linear trend either, it could be a case of arrhythmia.

The health monitoring device would be cost effective since the components used are cheap and available easily even on online marketplaces like Amazon. It could also be developed by anyone with a little technical knowhow as a simple do-it-yourself project. This would further benefit a greater demographic of the population since many do not use activity trackers because of the high cost associated with them.

Such a device could be accepted by older adults easily since it does not require any operation on their part, unless they want to actively turn it off. It would also help their family to keep tabs on them and it wouldn't take long to notice an emergency. A delay in calling for help in the case of adults living with chronic illness could prove fatal. Thus, such a device would not only alert help in case of an emergency, but also provide a possible diagnosis with a lowered chance of false positives.

CHALLENGES INVOLVED

There would be various challenges involved with the development, use and adoption of the proposed health monitoring system as well. The issues that require further deliberation are as follows:

- Psychological barriers may cause the target audience to refrain from using it. For instance, an adult would not want to perceive himself/herself as frail and in need of monitoring. Further, they may even consider it as an invasion of privacy.
- The user may simply forget to put it on, old age is often associated with forgetfulness.
- Tracking physical activity not akin to walking or running using the proposed sensing technology may be difficult.
- The format of the data collected is different from the format necessary for reflection.
- Issues with analytical accuracy. As holds true for any form of Artificial Intelligence employed, prediction and diagnosis of abnormalities may be less accurate as compared to human intervention.
- Extending battery life of the device would be an issue, given the size and cost constraints.
- Adapting according to the user would involve numerous use cases, all of which may be difficult to predict and would require the help of a specialist.

CONCLUSION

Although activity trackers are becoming more popular, there are still various use and adoption challenges associated with them especially in cases of older adults. Also, since there is a higher probability of older adults either not adopting well to the system or giving up halfway, modifying activity trackers to suit individual lifestyles to act as health monitoring systems for older adults would promote greater adoption and benefits.

According to [11], such a system would benefit the insurance industry as well. This implies we could expect the intervention of such firms in spreading awareness about the same to their clients. Better understanding about how users perceive such trackers are also enabling manufacturers of these devices cater to the needs of their customers better, especially in terms of reliability and ergonomics [12]. Overall, the society would be able to better adapt to the changing age demographics in India.

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