Agile Web Application Development: Displaying Twitter Trends to Better Understand Current Events Around the World
(Technical Paper)

How Reliable are Smart Fitness Devices?
(STS Paper)

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Computer Science

By
Jennifer Gulley

October 27, 2022

On my honor as a University student, I have neither given nor received unauthorized aid
on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

ADVISORS

Rosanne Vrugtman, Department of Computer Science

Bryn E. Seabrook, PhD, Department of Engineering and Society

Introduction

Smartwatches and fitness trackers are becoming increasingly popular with 190 million shipped worldwide in 2021 and expected to increase to an estimated 280 million in 2024 (Laricchia, 2022). One reason that fitness trackers have become so popular is that they motivate users in their workouts through goal setting (Niess et al., 2020). Smart fitness devices also allow users to connect and share their workout data with friends. "Social interaction" is another "key element to motivate users to perform physical activities" (Chen & Pu, 2014). However, there is concern about the reliability of smart fitness devices regarding the accuracy (Yang et al., 2015) and data privacy of user information (Ioannidou & Sklavos, 2021). Understanding how smart fitness devices collect, analyze, and protect user data provides insightful information into the reliability of the devices. The proposed STS research project will aim to answer the question "How reliable are smart fitness devices?" by focusing on accuracy and data privacy of these devices. My STS topic and my technical topic involve rather different issues, but there is a connection that I will discuss after introducing the technical topic.

For my technical report, I will document my experience as an intern over the summer of 2022, and I will describe how I worked with other interns to build a web application. Social media produces a vast amount of information that can be used to understand events around the world. However, social media applications, like Twitter, can make it hard to view global events. During my internship, I worked with other interns to develop a web application to display globally trending Twitter topics in a more user user-friendly manner so that users can get a better idea of current world events. The importance of social media ties together my technical and STS research topics. Fitness trackers have become their own social media for users to connect and share data with their friends while Twitter is a more traditional social media platform. I will

further explore the STS and technical topics in the remaining part of this prospectus, and I will

provide some background information for each topic. The STS deliverable will be a research

paper on the question "How reliable are smart fitness devices?" and the technical deliverable will

be a report on my experience as an intern creating a web application.

Technical Topic

Social media is a great tool for understanding events that are occurring locally, but these

social media applications can make it difficult to view global events, which places the user in a

bubble of only local information. A solution to this issue was to create a web application that

displays globally trending topics from Twitter in a more user-friendly way. To accomplish this

goal, a team of four other interns and I utilized agile software development techniques. We used

a specific agile framework called Scrum. My primary role on the team was as Scrum Master

where I guided the team in following best practices for agile development. I used Jira, a product

management tool, to track the development process and keep the team organized. I maintained

effective communication with the technical lead who tasked us with the problem. I also worked

directly on the software using development tools such as Spring Boot and Angular. By the end of

the summer, our team had a working application that displayed globally trending Twitter topics,

making current events from around the world more accessible. Future work on the application

might include keeping track of historical trends to see how the world is changing over time.

For the technical report, I will document how the other interns and I went about

implementing the web application. I will describe how we first gathered requirements for the

application, designed user interface mockups to visualize what the app would look like, and how

we went about software development. I will also report what I learned about agile software

development, and I will document which UVA classes were most helpful in preparing me for an internship.

STS Topic

Smart fitness devices like the Apple Watch or Fitbit can motivate users and hold them accountable to their fitness goals (Amaral, 2021). While these devices can certainly be beneficial in staying healthy, users also have concerns about them. One concern for users is that they are "uncertain about how accurately their devices track their data" (Yang et al., 2015). Users of fitness trackers certainly want their device to provide them with accurate health information. Otherwise, users will be more likely to stop using the device and to no longer be motivated to work out. Furthermore, receiving inaccurate information from a fitness tracker can cause "heightened anxiety" in users since they might worry about health problems that do not exist (Kussin & Mitchell, 2022). Relying on the information that smart fitness devices provide is significant to people who use these devices for motivation in achieving their fitness goals as well as for keeping track of their general health. Another reliability concern for users is data privacy and security.

Not only are users concerned with the accuracy of fitness devices, but they are also concerned about the devices protecting their data from getting into the wrong hands (Perez, 2019). Smart fitness devices provide an ample amount of health information but also store immense data on their users. Users cannot be completely sure where or how that data is being stored and protected, which can be cause for concern. In an article written by Phil Muncaster in 2022, he explains that one of the main privacy concerns of fitness trackers is the potential for "location-based threats." Muncaster explains that a hacker might be able to gain valuable insights into a user's location throughout the day based on their fitness tracker which "could enable [the

hacker] to physically attack the wearer, or their car/household at times it is judged to be empty."

Understanding how reliable smart fitness devices are in terms of data privacy protection is

important for users to feel safe and protected when using these devices.

It is clear from the users' concerns that they are one of the largest stakeholders in smart

fitness devices. Anyone can be a user of smart fitness devices, but specific users might include

those with health issues who want to keep close track of their daily health information or those

trying to get in better physical health. In addition to the users, the companies that produce the

devices are major stakeholders. The most notable companies are Apple, Samsung, and Fitbit.

Physicians might also be stakeholders as they may advise their patients to wear a smartwatch to

track their fitness and health related data. Third party companies may be indirect stakeholders

because fitness tracker companies may sell user data to them, which can provide valuable

information for advertisers (Muncaster, 2022). The growing ubiquity of smart fitness devices

means that they will likely have an impact on society. It can be helpful to explore these impacts

through a framework found in science, technology, and society studies.

Thomas P. Hughes put forward the idea of Technological Momentum, which describes a

relationship between technology and society. I will be using the framework of Technological

Momentum in my research to investigate how society interacts with smart fitness devices.

Hughes theorizes that "technological momentum infers that social development shapes and is

shaped by technology" (Hughes, 1994). In other words, society shapes technology and

technology in turn shapes society. Two critiques of this framework include Technological

Determinism and the Social Construction of Technology (SCOT). The former theory states that

"technological change drives social change" (Smith, 1994) while the latter asserts the opposite

that society shapes technology (Klein & Kleinman, 2002). Rather than a one-way causal

relationship between technology and society, Technological Momentum says that technology and society influence and shape one another. The bidirectionality of this framework is more applicable to smart fitness devices and users' concerns about reliability due to the nature of software development. User feedback is a key component in the software development industry, especially as a new technology develops. Users both adapt to the technology while also giving feedback to the producers who then make changes to the technology. Technological Momentum provides a useful framework to analyze how smart fitness devices and society influence and shape one another.

This research is important as smart fitness devices become more popular and more people are using them every day. Users want to know that their health information is accurate and that their data is being protected from hackers, third party companies, or anyone else that might cause them harm. Being able to understand how reliable smart fitness devices are is an important question for users and the companies that produce the devices. Users need to know if they can trust the devices before purchasing or using them. If they do not trust the devices, the companies must fix the issues so that they can continue to sell their products effectively.

Research Question and Methods

My research question is "How reliable are smart fitness devices?" To answer this question, I will conduct research using documentary research methods and discourse analysis. These methods will be useful in gathering information about how accurate smart fitness devices are as well as how such devices protect user data. Documentary research includes literature reviews, journal articles, and chapters of books and will be useful in gathering background information about smart fitness devices and supporting evidence for how they are or are not reliable. Discourse analysis includes less traditional sources such as non-scholarly articles, blog posts, and even social

media posts. Discourse analysis will likely be used to gather information about how users perceive the reliability of smart fitness devices. I will use the keywords "smart fitness devices," "fitness trackers," "smartwatches," "reliability," "accuracy," "data privacy," "security," and other similar words to search for sources relating to my topic. Using these keywords that are directly related to my topic will ensure that I find relevant information regarding reliability of smart fitness devices.

Conclusion

The technical deliverable is a report about my internship experience where I worked with other interns to create a web application to display globally trending Twitter topics in a user-friendly manner. The web application helps users who want to know more about current global events. The technical report will document how we developed the application and how we implemented agile software development. I will also report which UVA courses were most useful in preparing me for my internship and working at a software development company.

The STS deliverable is a research paper answering the question, "How reliable are smart fitness devices?". In the paper, I will present user concerns of smart fitness devices and determine how reliable such devices are in terms of accuracy of health information and protecting user data. I will also analyze how smart fitness technology and its users may influence one another using the Technological Momentum framework. Understanding these concerns can help users make more informed decisions and help companies develop better products.

References

Amaral, T. (2021, April 30). *The Pros & Cons of Fitness Trackers*. wellnessworkdays. Retrieved
September 12, 2022, from https://www.wellnessworkdays.com/post/the-pros-cons-of-
fitness-trackers

Chen, Y., & Pu, P. (2014). Healthytogether. *Proceedings of the Second International Symposium
of Chinese CHI on - Chinese CHI '14*. https://doi.org/10.1145/2592235.2592240

Hughes, T. P. *Technological Momentum*. (1994). Cambridge, Massachusetts. London, England.
The MIT Press.

Ioannidou, I., & Sklavos, N. (2021). On General Data Protection Regulation Vulnerabilities and
Privacy Issues, for Wearable Devices and Fitness Tracking Applications. *Cryptography*,
5(4), 29. https://doi.org/10.3390/cryptography5040029

Klein, H. K., & Kleinman, D. L. (2002). The Social Construction of Technology: Structural
Considerations. *Science, Technology, & Human Values,* 27(1), 28-52.
https://doi.org/10.1177/016224390202700102

Kussin, Z., & Mitchell, A. (2022, January 26). *Why fitness trackers are doing more harm than
good*. New York Post. Retrieved November 1, 2022, from
https://nypost.com/2022/01/26/why-fitness-trackers-are-doing-more-harm-than-good/

Laricchia, F. (2022, May 5). *Smartwatch and fitness tracker shipments worldwide 2021-2024*.
Statista. Retrieved October 18, 2022, from
https://www.statista.com/statistics/1290443/smartwatch-fitness-tracker-shipments/

Muncaster, P. (2022). *Every breath you take, every move you make: Do fitness trackers pose privacy risks?* WeLiveSecurity. Retrieved November 1, 2022, from https://www.welivesecurity.com/2022/01/26/every-breath-you-take-every-move-you-make-fitness-trackers-privacy-risks/

Niess, J., Knaving, K., Kolb, A., & Woźniak, P. W. (2020). Exploring fitness tracker visualisations to avoid rumination. *22nd International Conference on Human-Computer Interaction with Mobile Devices and Services*. https://doi.org/10.1145/3379503.3405662

Perez, A. J. (2019, August 16). *Use a fitness app to track your workouts? your data may not be as protected as you think*. USA Today. Retrieved September 12, 2022, from https://www.usatoday.com/story/sports/2019/08/16/what-info-do-fitness-apps-keep-share/1940916001/

Smith, M.R. (1994). Technological Determinism in American Culture. *Does Technology Drive History?: The Dilemma of Technological Determinism*. (pp. 1-17). Cambridge, Massachusetts. London, England. The MIT Press.

Yang, R., Shin, E., Newman, M. W., & Ackerman, M. S. (2015). When fitness trackers don't 'fit'. *Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing - UbiComp '15*. https://doi.org/10.1145/2750858.2804269