Sociotechnical Synthesis

Every major free software service such as search engines and social media are centered around the production and consumption of user specific data. These services generate value by collecting user interaction data which can provide personalized experiences such as targeted ads or media. The manner in which this data is collected has ethical implications. My technical research problem investigated how we can use personalized user location data in order to reduce the energy consumed by their phone's GPS sensor. My STS research problem investigated how recommender systems that are powered by personalized user data can harm the user. Together, they show how personal data can be used for both beneficial and harmful purposes.

The technical problem I investigated was how to improve the energy efficiency of mobile GPS sensors. One promising method is to observe patterns in user location data in order to find windows where the sensor can be turned off because there is no significant change in user location. For example, there is no need to continuously sense user location while they are waiting for a green light at a busy intersection. By collecting and analyzing past user location data, the GPS sensor can better choose the frequency at which to collect location data. My work uses a multi-objective algorithm to provide a variety of modes for the sensor to operate. It can either prioritize accurate readings at the cost of higher energy usage or prioritize conserving energy while providing less accurate readings. I tested my method in a simple simulated environment and found a modest 7-16% decrease in sensor readings to achieve the same coverage as a baseline always on sensor. Further validation in more complex situations is required to confirm the method's efficacy.

The STS problem I investigated was how recommender systems harm their users. Using actor network theory, I analyzed technical research papers on the weaknesses of current recommender system algorithms, read studies conducted on users who interact with recommender systems, and informally discussed the topic with my peers. I also was able to read the open source white paper for the Twitter (now known as X.com) timeline. My findings can be summarized as follows: recommender systems are designed to be addicting, provide harmfully biased recommendations which can lead to extremism, and come with a sleuth of data privacy concerns due to how companies try to cover up practices that are not in the best interest of their users.

While I was able to find a promising solution to my technical problem, there is a lot of room for further testing and I would not consider it solved. A simple simulation is not sufficient evidence for the method's efficacy in the real world. User location behavior cannot fully be predicted so sensitivity testing must be done to see how variation in user behavior affects the

performance of the method. As for my STS problem, I provided several strong arguments which support my thesis of how improper usage of personalized data harms users. Due to the proprietary nature of these systems and lack of experience, it was hard to find technical improvements these companies were working on to address these issues. Further research on regulations can also be conducted to incentivize companies to improve their recommender systems and alleviate the issues outlined in my STS paper.

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