Enforcing Temperature Entrance Requirements
With an Automated, Non-Contact Locking System
(Technical Paper, ECE)

Proposing a Tool to Illustrate Social Media Data Harvesting
(Technical Paper, CS)

Hands in the Cookie Jar: Exploring the Groups and Incentives that Influence
the Internet's De Facto Tracking Mechanism
(STS Paper)

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Introduction

Within a matter of weeks, the onset of the COVID-19 virus in the United States prompted dramatic changes to the way we live our lives. Toilet paper was sold out, personal protective equipment (PPE) was hard to come by, and non-essential businesses shut their doors (Schlanger, 2020; Sraders & Lambert, 2020). The first technical project in this proposal aims to address the impacts of the pandemic on small businesses, schools, and other brick-and-mortar establishments. During the reopening process, many such locations staffed their external doors so each potential entrant could have their temperature taken before entering the space ("Non-contact Temperature", 2020). These safety measures were costly for businesses to manage, and took time, but were necessary to keep people safe and drive foot traffic to the retailers that needed customers to stay afloat. In this technical project, a locking mechanism will be developed to automatically measure temperature and conditionally allow entrance if the user does not have a fever.

The remaining two projects in this portfolio deal with the business model of the modern social media company. These companies gather copious amounts of user information to sell precisely targeted advertisements to third parties. To enhance data collection, these platforms take steps to maximize user engagement and their efforts have been shown to contribute to public misinformation, political polarization, and mental health issues ("Impact of Social Media", 2019). The key to subverting the hold that social media has on our society is promoting public understanding of these tactics as many users do not know the extent of the data that gets collected about them online. In the second technical project of this portfolio, a new software tool will be proposed to help educate consumers on data collection practices. The proposal will contain example user interface designs, details of the inner workings of the application, and

analyses of costs, competitors, and broader impact. The third and final component of this portfolio is the STS research paper that will investigate the societal influences of a particular online tracking mechanism, the internet cookie. Cookies have become ubiquitous for tracking user interaction across online sessions and are a pivotal component of the online advertising industry. Understanding how cookies work, how they were developed, and how they are regulated is important to any critical analysis of online advertising.

Non-Contact Temperature Scanning Door Lock

The goal of this project is to combat the spread of the novel coronavirus, also known as COVID-19. As economies reopen, concern for public health has given rise to the demand for technology to find and monitor cases (Morrissey, 2020). For example, various contact tracing mobile applications have emerged that keep track of nearby devices, building a network of which users have been in proximity to each other. Thus, when a user tests positive they can privately and anonymously notify all other devices that were nearby ("COVIDWISE", 2020). However, these technologies are limited by the number of users they attract, and the willingness of these users to report positive results. One of the major goals of this project is to design a system where users participate by default to increase adoption.

The logical next question is who would have the incentive to ensure public safety as well as the power to enforce safety measures? Brick-and-mortar businesses, like restaurants and retail stores, are likely candidates. Their motivations are two-fold. First, for customers to return they must feel safe, so increasing safety precautions may drive in-person traffic. Second, safety measures protect themselves and their employees from the virus and from potential legal liability (Elejalde-Ruiz, 2020). Additionally, since these are privately owned businesses, they can generally enforce limits on who enters their property. Other potential targets for this type of

technology include health care centers and educational institutions. Health care centers, such as the UVA Elson Student Health Center, have been asking visitors to wait outside until someone manually takes their temperature and admits them. This entrance procedure relies upon visitors having the patience to wait outside, rather than entering immediately. Having health care center staff constantly monitoring the entrance may also be an inefficient use of their time. As for why an educational institution would be interested in this system, study spaces or rooms at the fitness centers would benefit from a monitoring system to screen more temperatures than otherwise possible and to inform cleaning needs.

While temperature is only one indicator of health, in the case of COVID-19 and other communicable diseases, it is considered critical screening metric ("Coronavirus Disease", 2020). There are many factors which influence body temperature, but it has nonetheless emerged as a primary screening technique throughout the pandemic ("Non-contact Temperature", 2020). This project seeks to make the temperature screening process safer for all involved. Therefore, the ECE capstone team proposes the development of an automated temperature screening system to conditionally admit prospective entrants to the sensitive spaces described above. This device will mount alongside a door frame, and temperature scans will occur without requiring physical device contact. If the temperature is within a predetermined bound, the user will be admitted to the facility. This way, temperature screening will require no additional human interaction which contrasts current methods where employees manually take temperatures with infrared thermometers. Furthermore, the device will synchronize with a web application that tracks usage and temperatures taken to provide the owners of the space with a holistic view of the door usage and allow cleaning measures to be focused appropriately. To aid in the development process, the team will use various computer aided design (CAD) software, soldering and testing equipment in

UVA's National Instruments Engineering Discovery Laboratory, and the 3D printing capabilities of the UVA Scholars' Lab. Finally, the team will summarize and report on the design process with detailed descriptions of testing, electronic design, software design, and manufacturability.

Illustrating Social Media Data Harvesting

Technology and social media companies have become some of the largest corporations in the world. How does Facebook make money? How does Google make money? The answer to these questions lies in advertising. Facebook reported a total annual revenue of $55.8 billion in 2018, and $55.0 billion of that came from advertising (Facebook, Inc., 2019). Google, a subsidiary of Alphabet, is no different, reporting $136.8 billion in revenue in 2018, of which $116.5 billion, or 85.4%, was attributable to advertising (Alphabet Inc., 2020).

One might naturally ask how selling advertisements earns so much money. To increase revenue, advertisers take advantage of various technologies to target the advertisements they show to online users towards products on which they are more likely to spend money. Consider the perspective of an online retailer that sells some product, for example sporting equipment, and wants to advertise to drive more traffic and sales to their website. Of the following two choices, which would this business spend more of their advertising dollars on: showing their products to a random selection of internet users, or showing their products to people who are known to enjoy outdoor sports? A shrewd business owner would choose the latter. This example may be oversimplified, but it demonstrates the basis of the online advertising industry. The more advertisers learn about internet users, the better they target whom they show advertisements to and the more they charge customers.

Large corporations profiting from the attention of their users may be more tolerable if they provided tangible social benefits. However, when evaluating the current state of social media, a

growing body of research suggests this is not the case. Among youth and young adults, social media has been characterized as addictive, contributing to lower self-esteem, lower life satisfaction, and mental health problems (Robinson et al., 2019; Hawi & Samaha, 2016; Yuchen, 2016). Social media overuse has also been linked to poor job performance and the platforms are hotbeds for polarization, having been used as recruitment tools for radical movements around the world (Zivnuska et al., 2019; Thompson, 2011).

Consumers have varying degrees of understanding of the online advertising industry and data mining practices. Research suggests that there is a "discrepancy between the practices of the platforms and the users' normative expectations" of how their data gets used (Kennedy et al., 2017). Without fully understanding the costs and consequences associated with otherwise free services, users cannot accurately assess risks online. The purpose of this technical project is to propose a software tool to mitigate the knowledge gap of data harvesting practices on social media platforms. The computer science capstone team will gather data on where public understanding is lacking, analyze current technology with similar goals, and assess the potential for market adoption. The technical process used to develop the proposal will focus on rapid prototyping and software architecture diagramming to demonstrate the look, feel, and inner workings of the tool. Finally, the proposal will address the costs and risks associated with implementation. Estimates of implementation timeline and resource requirements will be presented alongside discussions of the broader impacts the tool hopes to achieve. By elucidating the market need, technical design, costs of development, and anticipated impacts, the capstone team will provide faculty and other stakeholders with the necessary information to determine whether to implement the proposed tool.

Analysis of Internet Cookies

The United States Federal Trade Commission defines internet cookies as follows:

"A cookie is information saved by your web browser. When you visit a website, the site may place a cookie on your web browser so it can recognize your device in the future. If you return to that site later on, it can read that cookie to remember you from your last visit and keep track of you over time." ("Internet Cookies", 2018)

Internet cookies allow for continuity between visits to a certain website, such as remembering a login or shopping cart. Cookies were first introduced to the internet in 1994, and since then the relatively simple technology has been applied to more and more use cases (Frow, 2019). Of note is the use case of behavioral advertising, in which advertisers track browsing activity across sites to gauge consumer interests and target advertisements towards those interests (McStay, 2012). The online advertising industry fuels some of the largest corporations in the world and cookies are the "most common method of identifying and tracking online consumer activity," yet public perception and understanding of cookie usage presents a serious problem (Miyazaki, 2008). Jensen et. al (2005) find that while 90.3% of users surveyed claim a basic familiarity with cookies, only 14.0% could answer simple questions about their properties and capabilities. This project aims to address the problem of public cookie understanding, especially with respect to advertising, by surveying actors in the industry and analyzing their relationships.

The primary actors who shape the internet cookie landscape are consumers who visit web pages, government entities who regulate online privacy, technology companies that use cookies for tracking purposes, and the cookies as internet technologies themselves. Consumers of the web take part in cookie usage whether they are aware of it or not, though public awareness has risen in recent years (Bornschein et al., 2020). Government actors have started to regulate cookie usage more heavily. Legislation, such as the European Union's General Data Protection Regulation (GDPR), has affected how websites can employ cookies and what they must disclose

to their users (Koch, n.d.). Internet companies who make upwards of 80% of their revenue from online advertising have incentives to increase profits without losing users (Facebook, Inc., 2019; Alphabet Inc., 2020). Finally, cookies have their own impacts on online advertising, imposing a specific set of abilities and limitations for websites to utilize and exploit.

Actor-Network Theory (ANT) will be a crucial framework throughout this research. ANT was first formalized in STS by Bruno Latour and is broadly applicable in the social sciences (Cressman, 2009). The application of ANT involves identifying sociotechnical components that play a role in the development of a technology and determining how they influence one another. ANT is different from other STS frameworks because it considers non-human actors equally as it does human actors (Cressman, 2009). Thus, in this analysis, cookies as a technology actively impose restrictions on and affect other actors. Critics of ANT point out that the framework is overly general and too vague to properly answer pointed research questions. The "generality" of ANT will be used as an asset in this project where they key goal is to educate, inform, and explore the usage of cookies.

Methodologies

Research Question: How do technological, financial, social, and legal constraints regarding internet cookies coalesce in the online advertising industry?

When analyzing online consumers, the key areas of study will be perception of the technology and consent to its usage. Regarding government entities, research will focus prominently on the previously mentioned GDPR as it "has gone further than any other regulation or law to date in developing an understanding of consent to address personal data and privacy concerns" (Breen et al., 2020). Technology company actors are more difficult to research as they are private entities, so research will focus on business and management journals which may

contain insights into the targeted advertising business model in general. Lastly, cookies as a technology will be evaluated historically to understand the use cases they were designed for and how the intended use cases have developed over time.

Documentary research and network analysis will be the primary methodologies used in this project. Documentary analysis involves closely examining documents and literature qualitatively to interpret each source and gain knowledge about the research question (Bowen, 2009). The literature reviewed in this project will come from research databases provided by the UVA library system, including but not limited to SAGE Publications, JSTOR, and ScienceDirect. Preliminary research has identified "New Media & Society" and "Journal of Public Policy & Marketing" as two relevant academic journals which will continue to be explored throughout this project. Network analysis is key to Actor-Network Theory and involves identification of the members of a network and relationships between them ("Network Analysis", n.d.). Having already established the major categories that actors will fall into, this method will be useful for specifying actors in each category. Depending on the types of documentary sources found, a policy analysis method may also be useful when evaluating the GDPR and other regulatory actors.

Conclusion

This prospectus seeks to introduce three projects: a novel door locking mechanism reliant on wrist temperature scans, a proposal for a software system to educate consumers about data collection practices online, and a sociotechnical analysis of internet cookies and their use in online advertising. Development of the door locking mechanism will produce a physical device that is ready for installation and adoption by consumers. When mounted on a door frame, the device will take non-contact wrist temperature measurements and conditionally unlock the door

if the temperature is below a predetermined threshold. Each temperature measurement will then be reported to an online management dashboard where temperatures can be tracked and monitored. The proposal of the software tool will end with detailed designs of how the system will work and an analysis of the costs, risks, and benefits of implementation. Detailed system design diagrams will be presented along with depictions of the anticipated user interface. Completion of the sociotechnical analysis will result in a research paper. This paper will serve to inform consumers of the use of cookies in the online advertising industry and may also inform future legislation on the technology. These three projects unite in the theme of consumer protections. Whether from a global pandemic or the hidden risks of internet usage, these projects seek to inform and support consumers in the modern age.

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