Prospectus

Internet of Things Parking Sensor
(Technical Topic)

Google Glass: Lessons from IOT Wearable Devices
(STS Topic)

By

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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.

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Introduction

At the RSA Conference in 2013, it was estimated that there were 10 billion embedded devices ("Hacking Exposed," 2013). There are embedded microprocessors in appliances, cars, infrastructure, wearable technology, buildings and more. Enabling technologies such as low-cost computing, the cloud, and mobile technologies have led to an explosion of connectivity between us and in the artifacts around us ("What is the Internet of Things," 2020). The sensors, software, and computers that exist for the purpose of collecting and sharing data with each other have been dubbed the Internet of Things ("What is the Internet of Things," 2020). How to create technologies that responsibly connect and automate people, processes and the technological world around them in the IOT is a problem that many engineers face. To meet these ends, my team will develop a technology that would embed Bluetooth chips in cars, and receivers in parking spaces so that payment, parking permissions, and data collection could be automated and streamlined. Parking garages, paid lots, and meters would no longer need tickets, gates, attendants, or monitors as permissions would be handled automatically.

However, creating a successful IOT device is a task both technical and social in nature. For example, any increase in connectivity is accompanied by fears of increased surveillance and questions about privacy and security. I will research the social factors surrounding creating IOT devices as well, so that they may be resolved along with our technical solution. It is essential that all of the stakeholders in an IoT project are addressed, or society may reject the product outright. Worse, bad actors may abuse the system to erode people's right to privacy even further.

Creating technologies that responsibly interface with people and their digital identities as well as the technological world is a problem that is socio-technical in nature. Therefore, the solution requires both creating the technology and addressing the corresponding social factors.

Below I will describe my team's technological approach to this task, where we created an IOT Parking Sensor that identifies cars and handles their parking permissions automatically. I will also use Actor Network Theory to demonstrate how social factors are essential to an IOT solution, by characterizing an IOT device that failed to acknowledge them. Particularly, I will analyze how these rogue actors, such as privacy and surveillance concerns, led to the dissolution of the Actor Network, Google Glass.

Technical Problem Frame

In an attempt to further their respective dominant industries, Henry Ford and John Rockefeller demanded from city planners that there should be ample free parking to make sure cars were the cheapest transportation (Shoup, 2019). However, according to Bloomberg, research today has shown that cities requiring businesses have free parking has numerous harmful effects such as increasing traffic congestion, polluting the air, encouraging sprawl, raising housing costs, degrading urban design, preventing walkability, damaging the economy, and penalizing everyone who cannot afford a car (Shoup, 2019). Paid lots and street parking on the other hand discourage car use and provide revenue for cities as well as encourage turnover that helps local businesses (Vance, 2015). At the same time, cities are increasing in density and real estate increasing in price, strengthening the case for paid parking over free lots (Olick, 2020).

Current paid parking enforcement is done either by manual inspection of cars and meters, by permit-enforced gating, or by license plate recognition systems. There are also parking systems which use distributed sensor networks to measure capacity and to provide digital signage accordingly (Smart Parking Limited 2020). The most common vehicle detection method is the inductive-loop sensor, which uses a coil of wire in the pavement to sense a change in inductance due to eddy currents induced in the vehicle above. A typical use case of this technology is detecting vehicles at a drive through or stoplight. Another relevant technology is E-Zpass, a popular electronic road toll collection system which uses active RFID transponders mounted in users' vehicles to identify them as they pass through the toll plaza. In 2019, there were nearly 42 million active transponders which made 3.7 billion transactions (EZ-Pass Group, 2019). This provides a comparable for widespread electronic vehicle identification of some kind, and RFID tags were initially researched as a potential technology parking solution and inspiration.

Gating and license plate recognition are impossible to implement on the street, while parking meters or permits, de facto for street parking, have their own host of issues. The system is unreliable, costly, and inefficient: the driver must fiddle with the meter to pay introducing, and some other human must be paid to inspect the meter or check the car for a permit. The lack of automation here stems from the fact that the driver, the meter, and that the monitor do not communicate. The proposed solution could allow cities an automated, scalable and universal parking solution that would also better the user experience for drivers. Additionally, the system would make instantly available a host of information on all parking spots and user vehicles leading to boundless other practicalities.

The objective of this project is to develop a flexible, automated, and universal internet of things parking management system. It will provide insight into parking capacity and trends as well as to provide a system for assigning and enforcing restricted parking permits. This will be accomplished using BTLE wireless technology in a two-part system: a unique Bluetooth beacon mounted on each vehicle interfacing with a stationary wireless transceiver in each parking spot. These stationary transceivers, or base stations, will use an inductive loop to monitor the presence of a vehicle in the parking space and a database of permissions and registered BTLE tags to verify whether the vehicle in the parking space is authorized to park in that spot or whether the vehicle has been there for longer than it is authorized to be. In practice, the user could attach payment information to their car Bluetooth ID, allowing for seamless parking payment as well. The prototype design will be evaluated on the basis of cost, reliability, and software functionality to gauge its practicality and scalability in a real-world setting. Special attention will be given to ethical, environmental and manufacturing constraints as well.

STS Problem Frame

Consumer technology and marketing as of late seems to “smartify” everything and anything. There were smart phones, smart cars, smart watches, smart fridges, and now Google and Levi’s have brought us a smart jacket. According to a survey of experts, internet connectivity presents enormous potential for quality of life improvement, and consumers have certainly been receptive to these technologies, driving massive industry growth. The wearables industry, for example, is projected to grow 15.9% in the next 7 years (“Wearable Technology”, 2020). There is an unstoppable and ever-increasing amount of connectivity and data collection in people’s lives and things. Shockingly, though, while every conceivable type of IoT appliance and wearable technology was being integrated into society, one of these “next big things” failed spectacularly. Google Glass was the next ubiquitous, IoT consumer technology that never happened. The research here seeks to understand the social factors that surrounded this failure.

When Google’s smart augmented reality glasses were announced, they were believed to be the next super premium technology. The expectations around Glass were massive, and the media attention should have been enough to justify the high price tag. At the time in 2013, there was a forecasted 11-billion-dollar market (“BI Intellignce Forecast”, 2013). Furthermore, the incredible augmented reality features suggested in the marketing should have guaranteed a home run for Google. Yet, the glasses were discontinued in 2015 as a commercial failure, and there is somewhat of a consensus online and in pop culture that Google overpromised and under delivered, that the product was nerdy, clunky, and overpriced (Yoon, 2018).

That may be true, but this view overlooks the role that privacy and data collection played in the public's pushback against Google Glass. At the time, some critics raised concerns about the consequences of ubiquitous recording, since wearing the glasses meant wielding a camera all the time. One bar kicked out users in Seattle because of the privacy concerns associated with Google Glass and recording video, and others worried about the type of data Google could be collecting (Eveleth, 2018). In this highly connected and data driven world these social factors are essential in defining technologies and their place in society. If we continue to believe that Google Glass failed merely because it was a bad piece of technology in the consumer sense, we will neglect the role that concerns of privacy and surveillance played in the failure of this technology.

I argue that more important than the consumers, developers or technology itself in the failure of Google Glass were the privacy and surveillance concerns that go along with the prospect of digitalizing the very data taken in through the human eyes and the policies that dictate when people and things can be recorded. In actor network theory, technical, environmental, human and nonhuman actors are analyzed in how they relate to each other and function in a network. Google serves as a network builder; whose engineers recruit these heterogenous actors to solve a problem and form a socio-technical network in a process called translation. In this case study, ANT will be used to analyze how rogue actors surrounding Google's ubiquitous recording led to the failure of Google's network. Both backwards looking analyses of this technology as well as media from the time of the release, especially published by detractors, will be analyzed in this case study to better understand how this network failed and so that these concerns can be addressed in an IoT and surveillance-based society.

Conclusion

The technology world has long sought slick and seamless integration of every technology surrounding us into a broader, more convenient, smarter network. One proposed IoT solution is embedding Bluetooth transceivers into cars and parking spaces, so that parking management systems can be fully automated. This design will be scalable, so that it may become the universal way of parking. Permissions, timing, and car reservations can be managed in this prototype, and it could be easily expanded to allow for payment. This will also allow data about parking spaces to be collected to improve parking systems. Reinventing the way that paid parking is handled will be increasingly important because in present and recent times there has been a shift away from free parking requirements. This is because these lots take up space and encourage car use in a time period where land and carbon budgets are infinitely precious.

With any IoT or data solution comes a responsibility to consider all of the actors that may be affected or causing harm. The end of privacy seems to be an unavoidable paradigm and the past has shown that these technical solutions must be handled with care. To better understand these social factors, Google Glass will be analyzed to see how human and nonhuman actors, such as privacy concerns, led to a massive failure by one of the largest technology companies in the world. Although the two seem unrelated, Google Glass was supposed to be a ubiquitous IoT device like the parking sensor described here. To fully grasp the question of connecting the world, these social factors must be addressed.

Word Count: 1861

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