

**THE EFFECT OF ADVANCED TECHNOLOGIES ON THE GROWTH OF SMART
CITIES**

THE IMPACT OF INTERNET OF THINGS ON PRIVACY RIGHTS

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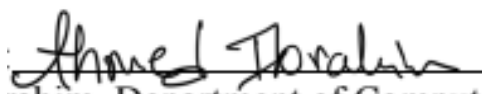
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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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According to reports from the United Nations, around 68% of the population might live in urban areas by 2050 (2018). The future will be an easier place to live, one with more conservation of energy and less pollution. As cities and towns grow over time they will evolve into smart cities. However, currently there is great poverty in many communities and no energy sustainability, which acts as a hindrance to the growth of communities. So while technology is being introduced to communities to aid their development, it would be fruitless because there can not be advancements if fundamental sustainable factors are not being provided in a community. Every community is unique and the factors that distinguish what are important for its growth are also unique. My technical project focuses on building a platform to fix problems within the community by building a bridge between the community members and city officials, to ensure optimal living conditions for a safer future. This platform will allow community members to post blueprint and project ideas for improvement they wish to see around the city, so that when city officials take actions to enhance the community, it would be on things the community members actually want. Under the guidance of Professor Ahmed Ibrahim, I will be working on a yearlong team with Cory Ayers, Luke Deni, Sanjana Hajela, Conner Hutson, Tony Lancaster and Jared Tufts to build this product for our clients Professor Sean Ferguson and Professor Tsai-Hsuan Ku. Tightly coupled with my technical project, my STS research focuses on the privacy rights that is concerned with the Internet of Things (IoT), which is a system of interrelated computing devices in everyday objects that enable them to send and receive data (Patel, 2018). Smart cities having amazing living conditions and that is possible through means of IoT, having devices that can send data in real time. However, the pro and con of IoTs, which make them controversial, is that the data that gets collected is seen by many individuals as a violation of privacy. Some people feel strongly against the collection of personal data and would rather not have advanced

assistive technology if that means no personal data of theirs would get collected. Thus, my STS research will focus on the impact IoT on privacy rights on a society in a social, cultural, and technology perspective.

We will be following the timetable shown below in Figure 1, to complete our project. Motivation for this research started when my group and I started noticing characteristics of the Charlottesville community, in particular paying attention to its high Gini index, a measure of income distribution in a population (Bargmann et al, 2018), and became filled with a desire to improve the community we call home.

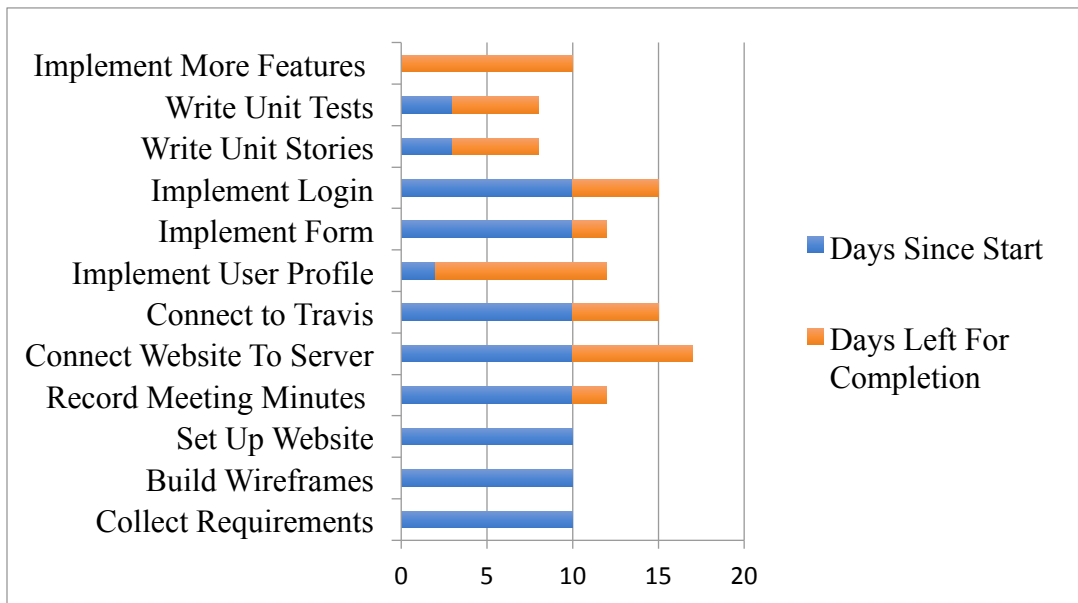


Figure 1: Gantt Chart: Timetable of tasks my team and I plan to complete (Sheth, 2019).

THE EFFECT OF ADVANCED TECHNOLOGIES ON THE GROWTH OF SMART CITIES

The implementation of technical online platforms has become an increasingly popular idea to engage residents of a city with local government, and the University of Virginia plays a vital role in this due to its technical expertise. Professor Ferguson and Professor Ku are part of the STS department at the University of Virginia, and they are conducting research with their STS 4500 students to develop research ideas for transforming Charlottesville into a smart city. These ideas, however, need a platform that can be viewed and contributed to by both residents and the local government. The research problem to be solved is how to efficiently communicate these ideas, and others, to the Charlottesville community to improve the city for the future.

Currently, there is no viable platform that solves this problem of lacking communication in Charlottesville, since the research problem demands different user types and custom databases that are unavailable with platforms such as WordPress. The work done by the current capstone group of this academic year will provide the first iteration of a solution to bridge the gap for collaboration between the university and Charlottesville. The capstone project will last the entire academic year of 2019-2020.

Creating a web application public to all users will address the problem in a positive way, by working to provide a safe, non-anonymous site for community members to share ideas of changes they want in the community through engaging discussions. The website will have a feature for users to submit blueprints for proposed projects where they can also add file attachments such as pictures. The platform will require users to register and login to submit posts and interact with other users. The users will be able to look at the projects and comment on them,

mark projects as “favorites” for easy access later, and connect with the authors of the blueprints via email. Community members can also submit smaller problems around the city to gain attention from other members so they can be fixed. There will be an “about us” tab where interested visitors can get in contact with the creators of the site and learn more about this initiative. The landing page will have a map that shows the Charlottesville area with ongoing projects pinned so users can explore projects in different areas by clicking specific pins on the map. Finally, there will be a resources tab describing places users can go to learn more about projects and current city work in general.

To build this website a strict set of requirements will be collected from Professor Ferguson and Professor Ku. Requirements contain the attributes and properties of features of a system that the user wants to help solve their problems. It is important to gather system requirements to correctly understand the goals of the client and to facilitate the work of the developers to best cater towards the stakeholder’s needs. Listed below are the capstone group’s minimum, desired, and optional requirements:

Minimum Requirements:

1. As a user, I want to be able to comment on a blueprint to give my support or feedback.
2. As a user, I want to be able to filter through blueprints based on what category they fall under.
3. As an administrator, I should be able to manage blueprint content by hiding or removing it.
4. As an administrator, I should be able to manage the privileges of other users (students, community partners, and community members).

5. As a student, I should be able to create my own blueprint space so that others may view it.
6. As a student, I should be able to view other student's blueprints.
7. As a community member, I should be able to leave comments on a student's blueprint.
8. As a community member, I need to be able to post blueprints.
9. As a community member, I need to be able to like specific comments or blueprints.

Desired Requirements:

1. As a user, I should be able to search for keywords that define the type of blueprints posting I want to look at.
2. As a user, I should be able to view blueprints based on specific location

Optional Requirements:

1. As a user, I should be able to comment on other comments.
2. As a student, I should be able to tag my post with specific categories.

At the end of the project, we will have a collaborative, online workspace reachable by both the Charlottesville community and academics at the university. Users will be able to post ideas, gather feedback, collaborate, and connect with university resources; the university can do the same, as well as be able to identify problems in the community that may have otherwise remained hidden.

THE IMPACT OF INTERNET OF THINGS ON PRIVACY RIGHTS

While technology is improving quality of life for many, Americans have rising concerns about their privacy being at risk due to these new technologies. IoT is a system of interrelated computing devices, digital machines, and people with unique identifiers, which have the ability to transfer data over a network without human-to-human or human to computer interaction (Patel, 2018). IoT works to optimize production and distribution of energy by storing sensors in various objects to collect data on users, such as their movement through traffic, with the goal in mind to build technology that will work to fix problems around the community, for example quicken traffic control. Though smart cities could reduce traffic congestion, this would be at the cost of knowing someone's exact locations and many individuals see tracking one's activities, as a problem. My STS research will work to see the impact on community by advancing technology and analysis of data collected by it.

IoTs are known for advancing the community. South Korea is the perfect example of a country that is highly prospering due to IoT. For example, in South Korea, whether its big cities or its small towns, IoT is taking over, changing everything from the utilities to the subways. Gochang, a relatively rural area in South Korea, was facing serious water leakage issues and it was hard for city officials to travel there every month to check up on water usage (Cho, 2019). The solution for this problem was a smart water meter, which allowed city officials to check on the water usage there remotely and in real time. This is such a high-priority issue, one that would have required immense usage of time and resources of the city officials to first travel to Gochang personally, maybe even repeatedly, to check on the water condition and usage. It is a waste of supplies if the water is leaking and does not get fixed because someone was not on time to check it. It would cost a lot of money to clean up the mess caused by the flooding. This is why

maneuvering towards IoT can be so useful because having smart applications implemented throughout communities can conserve so much money and time. However, all these advancements come at a price.

Technical advancements are not always a blessing. What many citizens do not realize is the large amount of data, often-personal data that is collected and analyzed in developing smart technologies. There have been instances of citizen's rights being scarified for the advancement of a technology or company. Figure 2 below shows a heat map from Strava, a popular fitness-

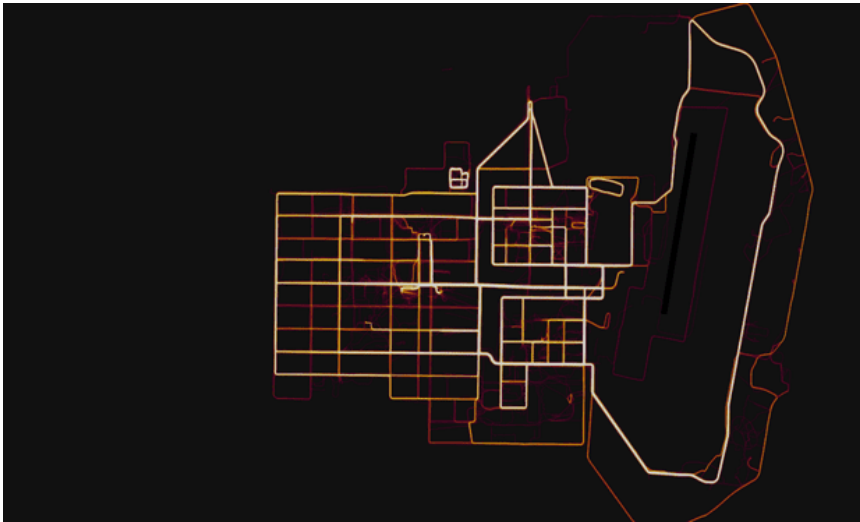


Figure 2: Strava Heat Map: This is a heat map realized from the application Strava, which is a snapshot of a map made from collecting individual GPS points. This map is of a military base in Helmand Province, Afghanistan with the routes taken by joggers that are highlighted through Strava (Hern, 2018).

tracking application. Strava leaked a heat map in November 2017, exposing more than 3 million user's locations, including users who were in remote military bases in Iran (Hern, 2018). On top of arguing with the media that the leak of confidential information was not their

fault they proclaimed it was the users who did not understand the privacy concerns. However, the reality is that this was a significant breach of privacy to their users, Strava had no right to do release these maps, and many people's lives could've been at risk. In the United States, most products are regulated by federal agencies so issues like these fall under their jurisdiction.

Federal agencies work to develop safety standard and enforce fair business practice laws.

Natasha Singer, a technology reporter for the New York Times who was recently a fellow at the

Data & Society Researching Institute in Manhattan brought up a good point, why does the government take action when Fitbits were said to cause rashes however when (Singer, 2019) does not go to form an agency that will protect our privacy rights in this modern day of social media when mobile or web applications like Facebook, Instagram, Fitbit, could be manipulating our personal information. Users of these applications often do not know when their data is being manipulated, and that makes the act even more dangerous but there is nothing to stop these powerhouses.

In the United States, there are no federal laws that address social media privacy rights. The closest thing that has taken place is the California Consumer Privacy Act (CCPA). CCPA put constrictions on how companies use and collect data. It gives citizens the right to know what personal data is being collected about them, know where and to whom their personal data is sold or disclosed to, say no to the sale of their data, and access their personal data (“California Consumer Privacy Act”, n.d.). This was a huge landmark, changing the power gears into the hands of the user. However, there is no federal legislation nor any other state that has released legislation pertaining to this issue so while users in California are safe, the same can not be said for other states.

SOCIETY’S EFFECT FROM THE INTERNET OF THINGS

Now that we have an understanding of the problem at hand, we will use the Pacey’s Triangle framework to identify relationships between the larger network of people who will impact or be impacted by adaptation of IoT. Pacey’s triangle organizes a technology into three main components: organizational, cultural, and technological. Pacey’s Triangle in the Figure 3 below depicts how the IoT would affect societal organizational, cultural, and technical factors of society and is not just an isolated practice.

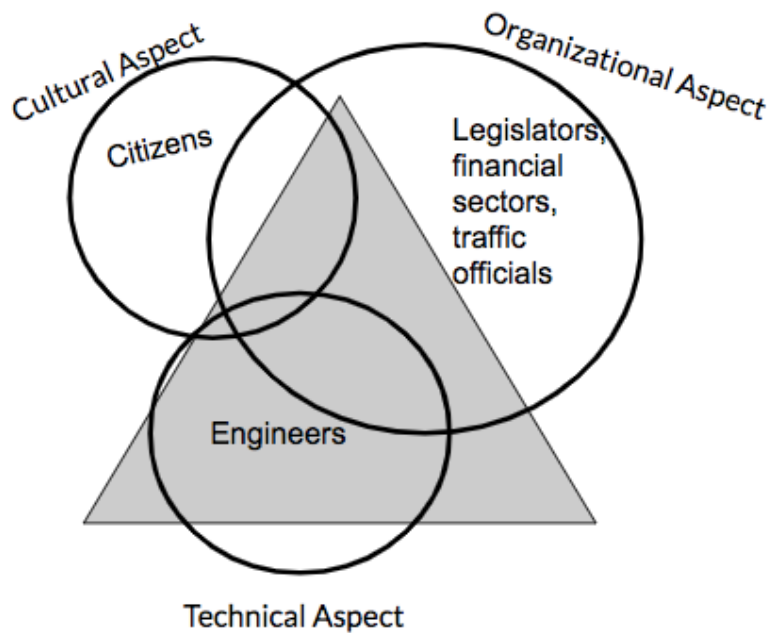


Figure 3: Pacey's Triangle: This is a framework that displays the relationship between the stakeholder's from a technical, cultural, and organizational aspect in regards to the effect of Internet of Things on society (Pacey, 1983).

While IoT sits in the center as the technology we will focus on, for the technological sector of the triangle the directly impacted stakeholders will be engineers. Engineers are the ones building the technologies that make up the IoT system. The engineers create tools like sensors and

cameras to mandate traffic and are in charge of maintaining the technology created to collect accurate data. Along with engineers with creating technology, engineers will be going through the data collected to derive patterns and conclusions and pass on that information to the government so that they can great changes based on this data. This leads to show the connection between technological sector and organizational sector is very large overlap.

The organizational sector of the triangle for IoT would include legislative bodies of the government, financial sectors, traffic officials, and those administrative roles that would be affected with advancements in technology. From an organizational perspective, these stakeholder's, for financial sectors and traffic officials will be very happy with the adoption of IoT because it would facilitate their jobs. In theory, organizational stakeholders would like this because this would facilitate their work, having quicker access to data to fix whatever problems may arise. However, for legislative bodies, due to the controversy on the issues from the opinions of the citizens that inhabit a community, it would be a stressful task.

In the cultural sector, from an ethical viewpoint, are the citizens being impacted by IoT. The citizens can see IoT in one of two lights: either positive because they have easier means to live day by day, having smart technology to solve their problems such as water meters in South Korea to ensure real time water updates as mentioned before, or citizens can see IoT as violating their privacy rights by collecting all this real time data, storing it and using it whenever the government or companies that collect the data deems it necessary. This is why the cultural sector has a big overlap with the organizational sector because the legislator's decisions have a direct impact on them. If legislators make no law to warn companies to regulate or limit the data they collect from users, then essentially these big technology companies are indestructible and this can end up really harming the user, as was the case with Strava. On the other hand if legislator's due pass as law that would restrict the data that gets collected, that would make citizens feel safer with the use of IoT software, and more willing to accept it as a part of the growth of technology. However, there needs to be some middle ground met from both sides and that is the difficult part to find out exactly what amount of regulation is the right amount. There is barely any overlap between technology sector and cultural sector because though the technology is collected and data is analyzed by engineers, citizens get more directly impacted by the organizational sector.

Through my research of seeing the effect of IoT on the community through different factors like cultural, organization, and technology, while also weighing where privacy rights fall in between all of these, and how significantly they will be effected, I hope to find out the next steps to create guidelines or understanding of how cities and communities can have IoT and advance, forming solutions to problems without jeopardizing their rights or safety. After I have finished researching and potentially reached an outcome, I will collect all of my findings and

write my analysis in a scholarly article that I can share with the world to continue future research or discussion on this topic.

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