Building A Multi-Purposed Smart Lamp

(Technical Paper)

Who Owns Our Home: Consideration of the impact of adopting Smart Home System

(STS Paper)

A Thesis Prospectus Submitted to the

Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements of the Degree

Bachelor of Science, School of Engineering

Jiahe Tan

Fall, 2020

Technical Project Team Members

Issac Li

Qiyue Wang

Sihan Ding

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

Signature _____ Date _____

Jiahe Tan

Approved _____ Date _____

Harry Powell, Department of Electrical and Computer Engineering

Approved _____ Date _____

Sean Ferguson, Department of Engineering and Society

Introduction

With the development of technologies and internet, intelligent life has gradually entered our lives. Smart home can be said to be an automated Internet ofThings system. People can use this system to enjoy more efficient and interesting services. For example, you can control the temperature of your air conditioner through your mobile phone or smart speaker. Many Technology companies are also working hard to promote “smart home”, and most users have a fresh and curious wait-and-see attitude towards “smart home”.

Both my technical project and STS project focus on the topic of smart home system. For the technical project, our team will build a small smart home device practically. For the STS project, I will be basing on the practical experience and develop a more theoretical idea. My technical project is to proposed a new smart home device: a multi-purposed lamp, which is a special smart lamp ideal for both daytime and nighttime illumination together with three other computer engineeringmajor undergraduate student. We are currently working on building a prototype of our lamp. For the STS project, I will be researching into how people are adopting the smart home devices and explore how some smart home technologies are used in people’s home. I will then discuss why some individuals are moving to smart homes but others have fears and concerns of drawbacks of smart homes. The drawbacks will include the major issues of privacy and data breaches.

Technical Topic

My technical project proposed an actual smart home device and build a prototype with small budget to imitate the actual manufacture, production and sales. The overall purpose for the

technical project is to build a lamp primarily used as night illumination but also ideal for daytime illumination. People usually use nightlights for security reasons when waking up at night. A common night light is a small, low-power electric light kept on at night for comfort and safety. It can provide people with enough light to see the room, but they are also dim so that the light will not disturb sleep. However, common night lights are usually plugged into the walls, which makes them not portable. Moreover, most night lights only have a single function. This project solves the problems. It provides a carrying option. It also adds daytime lamp function and automatic brightness control function. In addition, our smart lamp is able to memorize the actual preferences of illumination levels at different time spot, and is able to provide

There are a few similar products available commercially. Many companies have manufactured adjustable Led night light. The MAX-TEK Store has produced aplug in Led night light with manual brightness adjustment and automatic illumination. The TaoTronics Store has manufactured a touch sensor table lamp which allows adjustment of brightness through a touch sensor.

Our project differentiates itself from the competition in three major ways.
The brightness of the lamp can be adjusted not only manually but also automatically since we have auto mode and manual mode. Another difference is thehandle and the automatic lighting up mechanism. When the lamp is in the nighttimemode, user can lift the handle on top and the lamp will be automatically lighted up. With this design, it is perfectly suitable for waking up at night. People who use our lamp can carry this light around and go to the bathroom or get a cup of water if needed. What makes our smart lamp more convenient is that our lamp can

memorize the preference of brightness level and will upload their daily illuminationlevel routine to the cloud for analysis and calculation so that it will provide user customized brightness level at different time slots.

Our project contains two parts: the software part and the hardware part. For the software part, since our lamp is required to be able to switch between different mode, a microcontroller is needed and we have already completed the design of themicrocontroller algorithm and are working on the actual coding. For the hard ware part, we used a light dependent resistor (LDR) to achieve the effect of automaticallyadjust the brightness level. The design of LDR circuit is to produce a variable DC signal according to the surrounding light intensity. We also designed a LED driver circuit to provide enough power to the LEDs and to adjust the brightness of the LEDs through the voltage provided.

I will be working with Andrew Ding, Isaac Li, Tiger Wang on this project for this semester, and our technical advisor is Harry Powell. My major responsibility inthis project is the microcontroller firmware, which includes the design of the microcontroller algorithm, the finite state machine, and the actual coding part.

STS Topic

Introduction:

With the continuous update and rapid development off technology, the subject of internet access will happen to change. Currently, the subject of Internetaccess is human. In the future, the subject of internet access will become a object,which will truly realize the connection of things to things. Nowadays, smart home devices are more than abundant. Different products

of smart homes are interconnected to form different systems, and together, they are shifting from mobile phone control to voice control and later on will shift to human-computer interaction mode. However, when more and more people are adopting smart homesystem to their houses, there are some questions yet to answer: In what way are people using smart home system? To what extent are smart homes benefits people? Are there some drawbacks that affect people's normal lives, if there are drawbacks, do the benefits cancel out drawbacks, or the drawbacks outweigh the benefits?

To address these questions, I will first research into why some individuals aremoving to smart homes to find out the benefits of smart homes. I will then explore how people are actually utilizing the smart home devices they adopted in reality.

After this, I will address why other people have fears and concerns of drawbacks ofsmart homes. The drawbacks will include the major issues of privacy and data breaches.

The potential benefit of smart homes

When people first adopt smart home devices, their primary motivation is a desire to save energy and associated costs. (Hargreaves et al, 2018) They hope thesmart home appliances that can be turned on or off automatically can save energy costs and help them with long term energy management. The scenario is that whenpeople are on the way to work but suddenly find that the TV is not turned off. With the smart home, they can turn on or off the electrical appliances at home by opening a app on their phone.

The second most common motivation was people's interest in new technology. This kind of people think that with the adoption of smart homes, theirlives will be more convenient and their house security will be improved.

How people are utilizing the smart home devices

People usually have high expectations on smart homes when they first bought them. However, as time goes on, expectations are usually counteracted byreality.

In the early stages of using these smart devices, people usually found the cognitive, practical and symbolic work of domestication challenging. There is another possibility which is that people who are adopting the smart home devices issomeone who is technically proficient, but they can be easily thwarted by other people in their home who have limited knowledge and interests in technologies.(Goulden, 2019) Also, since usually people who made decisions in a home is those older people, and they are more likely to think adopting a new form of using appliance is demanding and resist to corporate. In longer term, people tend to use less instead of more of the functionalities provided by the new appliances than the early stage. According to the research conducted by Tom Hargreaves, some households even reverted to exclusively manual control.

Also, when people bought smart home devices to their home, people usually want to just buy one product of the entire system. However, IoT-based smart homeservice is not just a single service but a whole platform that will provide services in every moment of users' residential life (Kim et al, 2017). Therefore, people just

bought a small component will not have an impression as good as those who adoptthe entire system.

Drawbacks of smart homes: privacy issues

Among all the drawbacks mentioned above during the utilizing process, the major issue is the privacy and the potential data breach issue. While people are using smart home devices, their daily routines and other information are uploaded to the cloud for analysis and calculation. In our technical project, we also acquired user's preference on light intensity and uploaded to the cloud. Security and privacyflaws can be introduced in IoT through interactions among different devices that supporting a smart home system. If there are criminals intercepting it midway, people's privacy will be exposed. However, there are few literatures research focuson this issue. (Geneiatakis et al, 2017)

To make things even worse, big tech companies are doing little on data breach issue. home should be a trusted area, therefore technology companies should try solving the security problems of smart home products so that their consumers can enjoy the service without considering security issues. However, privacy and security are sometimes the least important things to be considered intheir mind. User information protection is additional costs for tech companies andeven sometimes, user information can be used to make additional income, which benefits the powerful tech companies.

Next Steps:

With more and more people want to try stepping into the field of smart homes and adopting some of the smart home devices, more and more smart home products appear on the market. From the analysis that I made above, to make consumers satisfied and increase sales, the major selling points are privacy controlsand user-friendly features that can be used for a long time.(Pillan et al, 2019) In the following thesis, I will be investigating how companies are reacting to these needs. I plan to do two case study, one on Google or Amazon, the other on XiaoMi,which is the biggest smart home companies in China. After case studies, I will conclude my thesis by propose some suggestions in my perspective on these issues.

References

Geneiatakis, D., Kounelis, I., Neisse, R., Nai-Fovino, I., Steri, G., & Baldini, G.(2017, May). Security and privacy issues for an IoT based smart home.

In 2017 40th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO) (pp. 1292-1297). IEEE.

Goulden, M. (2019). 'Delete the family': platform families and the colonisation of

the smart home. Information, Communication & Society, 1-18.

Hargreaves, T., Wilson, C., & Hauxwell-Baldwin, R. (2018). Learning to live in asmart home. Building Research & Information, 46(1), 127-139.

Pillan, M., & SaraColombo. (2017). Will smart homes improve our lives? A designperspective towards effective wellbeing at home. The Design

Journal, 20(sup1), S2580-S2591.

Kim, Y., Park, Y., & Choi, J. (2017). A study on the adoption of IoT smart home service: using Value-based Adoption Model. Total Quality Management &Business Excellence, 28(9-10), 1149-1165.