Prospectus

Technical Report- The Game of Pedagogy

STS Thesis- Lessons from the World: How to Build a Grid

Presented to the Faculty of the School of Engineering and Applied Science

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Overall Introduction

In Charlottesville, many people suffer from blackouts and inadequate energy provision, and when service is poor, they have little room to seek alternatives. Recently, Dominion Energy, which has a monopoly on energy production for the Shenandoah Valley, has begun to make their grid more efficient and more capable, but even in areas where population density is reasonably high, apparent inefficiencies and ugly wiring dot the streetscape, decreasing not only the beauty of the iconic Charlottesville streets but also the efficiency of the energy grid. And, in places where the service is most unreliable, the property value of housing is naturally decreased, meaning that the people at higher risk of living in poverty necessarily have a higher chance of being affected by outages.

I seek to find a set of workable solutions to this problem, especially regarding lightening the strain on the grid as it is, and providing efficient and durable energy solutions to people who frequently experience outages. My personal research revolves around the ability and practice of people within high-tech and high-density places, especially in China, and solutions these people have synthesized to reduce the strain on the grid, and provide for themselves in the event of an outage, as well as the ability of programs in Charlottesville to apply those strategies to their own lives. In other words, "what can the Charlottesville community learn from dense communities worldwide about consistency in an energy grid?''

Technical Topic

Mark Floryan, a Computer Science professor at the University of Virginia, is dissatisfied with the way classes are currently taught. Floryan believes that strict deadlines and one-time assessments are not optimal for learning. Floryan seeks to understand the efficacy of gamification as an alternative method for learning. In his proposed system, students advance through a course as they advance through a video game: at their own pace, with deliberate practice and immediate feedback. Course material will be organized by topic, allowing for class progress to be visualized as a graph. Professors and students alike can see their progress in real time with on-site quizzes and automated grading.

Many classrooms today use the lecture-based exam model. In this model, lectures are the foundation of the course; quizzes, homework, and exams are all contingent on the lecture material. This solution forces students to learn at a controlled pace outside of the classroom, often causing students to move on from a topic before they have mastered it. Floryan's system aims to allow students to work at their own pace outside of the classroom and to make the mastery of a topic feel like beating a difficult boss in a video game.

Requirements are important because they enable clients to express their desires in a clear and unambiguous way. By converting client wishes to requirements and reviewing those requirements with customers, software developers can confirm that the product they will create matches the client's needs.

In the previous academic year, this project was started by a different team under the original set of requirements. Our contribution to the system includes adding security and authentication, improving performance at scale, aligning the system with Floryan's course, and adding quizzes and auto-grading. Based on several meetings with Floryan, we assembled this list of requirements for our contribution. (*see Figure 1*).

STS Thesis

In the wake of global crises throughout the mid-to-late 20th Century, the United Nations and other members of the global community identified a large array of basic needs for the average citizen, including electricity (4). However, in Virginia as well as various other communities, electricity becomes tenuously available, due in part to environmental circumstances, but also due to negligence and inefficiency in power grids which serve the populace. Additionally, not every configuration of power grids benefits each citizen equally, which begs the question: Does the power grid in Charlottesville *really* provide the best service it can provide, without neglecting disenfranchised neighborhoods and the like? In other countries, especially China, federal governments control the distribution of electricity, and are accountable to all citizens, especially those who are disenfranchised. Analyzing the means by which Chinese governments and Chinese citizens tackle energy inefficiency issues can provide a source of innovative policy and technology changes that could provide for intervention opportunities, restoring the public service of energy to the citizens of Charlottesville.

The issue of energy provision and consumption in Charlottesville becomes rather complicated after first glance, and so to better understand how stakeholders find issues with the current system and how their designs handle those issues, we can investigate this issue using the framework of Social Construction of Technology, or SCOT. Using this framework, we can diagnose the extent to which the existing grid-consumer paradigm has disenfranchised Charlottesville's citizens, and how this social group can leverage their community, an increase in technological capacity, and the knowledge gained worldwide to create a better, more consistent infrastructure. Specifically, our project seeks to analyze the potential for a particular techno-social innovation (independent hybrid energy sources) to impact the current energy landscape in Charlottesville as both a platform for positive environmental impact and as a means by which to compel market-dominant companies like Dominion Energy to provide for disenfranchised communities.

In preparing for this project, a variety of resources were collected and consulted, especially in regards to business practice and the ability of individuals to impact their energy usage. As regulations and codes currently stand, many individuals lack the power to change the way they consume energy, or to investigate cleaner, more efficient options. This power tends to fall to landlords or other leasing agencies (2). As a result, many of Charlottesville's landowners may own property in historically at-risk neighborhoods, but they may never actually experience the outages which can plague these areas without living there themselves.

Large companies tend to dominate the general American discussion surrounding Smart Cities, and by writing the "rulebook" on how a Smart City should function, they can strategically ignore common interests of most citizens (3). This means that big companies like Dominion Energy in Charlottesville, though proclaiming to enact "Smart Energy" policies (7), can move the goalposts on the definition of Smart Energy in order to avoid making meaningful improvements to the situation of the disenfranchised. In the short term, working harder to build reliable grid systems and implementing high efficiency energy practices would be a costly venture, but in fact these practices have been shown to decrease the overall load on the grid as a whole, and to increase the economy in affected areas by as much as 50 percent (1). With such a profitable upside, it would be much easier to work with and advertise to a big company such as Dominion, if and when such a situation may occur.

In the last decade, China, the country most responsible for greenhouse gas emissions and the country most filled with million-resident cities, has marked energy efficiency and cleanliness as a more pressing issue. In its dense, highly packed cities, the many skyscraping buildings contribute more CO2 towards air pollution than vehicles, so making buildings and infrastructure more efficient directly improves the air quality. From 2006 to 2010, China implemented a Five-Year Plan which reduced its emissions rate by 400 million tons, and this stride for cleaner practice also improved the energy grid's efficiency by 19.1 percent. (6)

Outside of literature, the STS group has begun to reach out to members of the community, seeking feedback and advice on how best to help improve the energy situation in Charlottesville. In my personal research, I've consulted with a graduate student at Tsinghua University in Shenzhen, China. During our discussions about the notion of a Smart City, I've been able to learn about practices which have bolstered the pursuit of energy efficiency in China. As is the case in America, consciousness of one's energy consumption often leads to improved energy practices, but when larger organizations exist (such as the government, when in China), the reminder to use best practice can much more readily be administered to many citizens. When considering the problem of consciousness in Charlottesville, the constant reminder to use best practice might be more effective when given from a position of centralized authority.

I hope to gain more information about specific large-scale practices used abroad, especially in China, as the best means by which to learn about efficient-grid methodologies. Additionally, I hope to continue interfacing with interested parties in Charlottesville and similarly-minded researchers here at the university, designing the best means by which to create an aware and active community of high-efficiency energy consumers, bringing both the local interests in Charlottesville and the proven practices in China together to synthesize a workable solution for communities not only in Charlottesville but also elsewhere.

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Figures

Figure 1:

Minimum Requirements:

- The system must secure student data and grades such that they are only accessible by that student and by the course staff
- As a professor, I want students to only be able to see course topics that have been unlocked
- As a professor, I want to be able to lock and unlock topics from within the client
- As a professor, I want the students to be able to see their grade for level of competency per topic
- As a professor, I want to be able to upload grades in csv format

- As a professor, I want to be able to upload large amounts of data quickly (50,000 instances)
- As a user, I want the system front end to not experience notable lag when the database contains large amounts of data

Desired Requirements:

- As a TA, I want to be able to access and modify student grades from the frontend
- The system must be secure at the network level by encrypting traffic with HTTPS
- As a professor, I want the system to be able to store arbitrary assignment grades associated with a topic
- As a professor, I want to be able to toggle between cutoff grades and percentile grades per course and per topic
- As a professor, I want to be able to customize the thresholds for cutoff grades per the course and per topic
- As a professor, I want to be able to import grades from Bloomfield's new 2150 system
- As a professor, I want to be able to administer multiple choice questions
- As a professor, I want to be able to auto grade quiz submissions and provide immediate feedback
- As a professor, I want to be able to administer parson's problem questions
- As a professor, I want to be able to create quizzes from a question bank and to specify how the quizzes are to be generated
- As a professor, I want to be able to administer short answer questions
- As a staff member, I want to be able to grade short answer questions

Optional Requirements

- As a professor, I want to be able to administer short answer questions
- As a staff member, I want to be able to grade short answer questions
- As a professor, I want to be able to administer and grade coding questions