Human-Powered Vehicle

(Technical Paper)

With the increasing use of IoT devices and the subsequent development of "smart" cities, why is government intervention beneficial for maintaining the credibility and security of data?

(STS Paper)

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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

There are billions of people around the world that lack access to affordable and reliable transportation. Transportation is not a staple of day to day life for everyone; in many cases, transportation is an integral piece in allowing people to carry out the necessary tasks on a daily basis to provide shelter, food, and water to themselves and their families. In such areas of the world, human powered transport is increasingly becoming the only viable option. My technical project acts to design and build a highly engineered, efficient human powered vehicle to offer a sustainable form of transportation to those who do not have access to modern transportation systems and methods. Additionally, the vehicle will be entered into a competition where it will be tested and scored for various design and performance parameters. The goal is to perform well in the competition complimented with a well-documented process and research

As cities become "smarter" while simultaneously experiencing a convergence of physical and digital infrastructures, the need for government-enforced cybersecurity regulations is becoming much more profound due to the increased susceptibility of governments, corporations, and individuals to misuse of public data. The rapid modernization and digitalization of the innerworkings of cities and lack of education and governance of its constituents leaves cities vulnerable to cyber-attacks that can affect a broad range of city services. My research prospectus attempts to answer the following question: As cities become "smarter" with the increasing use of IoT devices and, as a result, sharing of open data, why is government intervention important and beneficial for maintaining the credibility and security of data?

Technical Report

Human-powered transportation has been a part of our existence, defining basic human behaviors and activities. Whether it be walking, running, swimming, cycling, or skateboarding humans have found innovative transportation methods to account for improving speed, endurance, and design. Further, the advancement of technology over time has led to the emergence of the human-powered vehicle. Human-powered vehicles are all vehicles that are powered only by human muscular strength. As modern technology continues to improve at an astounding pace and machines are more capable of channeling human power, human-powered vehicles have become a subject of significant interest as they can be modified to fit the exact need of the rider.

In parts of the world that are underdeveloped or inaccessible, well-designed human powered transportation is becoming an increasingly more practical form of sustainable transportation. The technical report of this prospectus focuses on the need to design a human powered vehicle to meet the specific set of performance specifications created by the American Society of Mechanical Engineers for their Human Powered Vehicle Challenge. Through this competition, the American Society of Mechanical Engineers offers students an opportunity to apply their knowledge garnered from their studies and apply sound reasoning and engineering principles to design and build a human powered vehicle for everyday use, such as parcel delivery or commuting to work. The vehicle must stop within 6.0 m from 25 km/hr, have turn radius of 8.0 m, travel for 30 m at 5-8 km/hr, and a Rollover Protection System (RPS) that can withstand a 2670 N top load and 1330 N side load in order to be eligible for the competition. In addition to having these performance specifications, my team's goal was to build a stable, fast, and agile human powered vehicle that is lightweight and can be used by a range of anatomies.

Before attempting to create our own conceptual design, we needed to perform preliminary research on different bicycle types and configurations and explore what principles, methods, and innovations teams had exploited in their vehicles in past competitions. Following the discussion and analysis of each group member's research, we formed small groups in which we developed conceptual design reports and presented them to the class. These reports were not too comprehensive; however, the background research and analysis conducted for them provided a basis for the next steps. Next, we split into teams from which frame and drivetrain sub teams were also formed. The first task that my team wanted to address was the design summary of our vehicle, which outlines wheel configuration, frame geometry, drive system, and other macro-structural features. Utilizing our design summaries and performing some additional research, we decided on a three-wheeled, recumbent, tadpole configuration (two wheels in the front and one wheel in the back) constructed of AISI 4130 steel. The tadpole design allows for riders to have a more stable ride than that of traditional bicycles, while maintaining the ability to make turns at higher speeds. The recumbent feature of the vehicle provides riders with more efficient energy expenditure and comfort as less force is placed on the lower back and joints. With these design features, my team created a CAD model of the frame design on which we could perform finite element analysis testing on the frame. The results of this testing were used to modify the frame to meet competition and personal specifications. Additionally, biomechanical and ergonomic testing were performed to determine the gearing parts and pedals, chain path, wheel size, and seat configuration. Each week the frame and drivetrain sub teams work independently toward a set of tasks and goals, reconvening at the start of every week to integrate each other's designs and identify areas of correction or adjustment. Currently, my team has ordered the seat, wheels, gearing group set, and steel tubing and is working on designing a fairing that can be detached, while continuing to perform biomechanics testing to optimize rider power output. Our current focus is to finalize our frame model so that we can begin the initial stages of the manufacturing process, as this process the most time-consuming, requiring an abundance of testing. The current expectation is to be prepared to start the final construction of the frame and integrate drivetrain features with frame at the start of next semester.

STS Research Paper

In his article "Datapolis: A Public Governance Perspective on 'Smart Cities'," Albert Meijer claims "technological development is unstoppable and will bring wealthier, safer, and more sustainable cities" (Meijer, 2017). This theory is seemingly understandable; technological development leads to the improvement of existing technologies, eradication of insufficient technologies, or creation of new, revolutionary technologies. However, when it comes to using technology in a city to address specific issues, it is never a purely technical problem. The implementation of technology is not only a matter of sound engineering application, but also a function of political, social, and economic factors. Given the significant advantages of access to open and transparent data and IoT devices, it is crucial that the data accrued by these resources is secure so that sensitive information is protected. Government intervention is necessary for regulating the sources and accessibility of open data in order to effectively promote the use of such data while ensuring its security.

IoT devices heavily impact the way businesses of any industry operate and play a critical role in how smart cities and their markets function efficiently. To start, IoT devices already enable businesses to monitor and manage their inventories automatically in order to free up workers for more important, complex tasks, ultimately leading to higher productivity per worker and higher returns for the company

(Meijer, 2017). Another advantage of IoT devices is that they allow businesses and consumers to research and compare buying options, therefore, fostering more competition and technological innovation and fair and legitimate marketplaces (Sappin, 2017). Lastly, as the integration of IoT devices increases, each sector of a city will experience enhanced interconnectedness leading to faster service responses (Janssen & Kuk, 2016). Given the current and increasing widespread use of IoT devices, the openness and transparency of data is more evident than ever before. The openness of a massive inventory of data offers corporations and individuals access to a virtually infinite amount of information. Small businesses benefit from the massive amounts of online and offline information available by making informed, analytic-driven decisions to compete with big corporations and government entities. Further, local data collected by governments and businesses is utilized to account for niche groups of customers (Sappin, 2017). The extensive use of the internet and the resultant abundance and openness of data has come to define the daily operations of a modern city. The centrality of data usage and storage in a modern city is an area of concern due to the risk of cyberthreat and improper exploitation of sensitive information, a risk that can be mitigated by government intervention.

Modern cities are considered datified, meaning all activities, incidents, conversations, and interactions are being converted into data and stored. The collection and use of data is a connecting thread between more effective transport systems, better waste systems, more efficient energy use, stronger surveillance systems (Meijer, 2017). This datafication of society is a very tangible and real phenomenon that is occurring at every instance in time as all actions and operations are generating data. Making data public which in essence exposes the digital information of all members of a society becomes a public concern, a governmental concern. Public governance does not only have to do with governing local municipalities, but also influencing the interactions between the government, private, and individual sectors of a city. The challenge of governing smart cities that possess transparent and open data is guaranteeing checks and balances in access to information to generate a balance of power between various groups in the city.

The uses of data are applicable to virtually any of the varying sectors of a city. Municipalities and government agencies use data to enhance efficiency and effectiveness of government to boost legitimacy. IT companies and digital platforms use data to elevate profits, but only can do so if it provides value to the city. Public-private smartness increases when government and companies share data. Individual citizens and their society organizations use of data contributes to the idea of urban smartness by developing new forms of collaboration between citizens to address and tackle different urban problems (Meijer, 2017).

Policy implementation needs to be better understood as an effort to exert power, build alliances, generate passion, and gain support. Public administration should use technology as an instrument to realize policy objectives, such as safety, health, and administration. In this case, technology is thought of as an extension of the bureaucracy that works hand in hand with elected administrative officials (Meijer, 2017). The goal is to balance different perceptions of urban problems and not just build upon quantitative data for uniform urban management.

The convergence of physical and digital infrastructure has never been more prominent than it is in today's society. As smart cities attempt to integrate the physical and digital world to vastly improve systems, cyber security has never been under such a microscope. The number of IoT devices connected is skyrocketing and those who are unprepared are at extreme risk for data theft or corruption. Smart cities must focus their attention on cyber threat and how they can minimize such issues for their citizens, businesses, and municipalities.

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