MONITORING WEB APPLICATIONS: AN AUTOMATED APPROACH

SPACE JUNK: CONTRIBUTING TO THE RISE OF DEBRIS IN ORBIT

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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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General Research Problem: Cleaning up Technology as New Faults Are Found

How should technology be monitored in order to prevent negative outcomes, and what are some factors that would discourage owners from maintaining their technology effectively?

Maintaining a new technology after its initial development has many advantages. In some fields, such as software, maintenance is a cost-saver: the faster you find an error in software, the easier and cheaper it is to fix it. In fields where people are operating heavy machinery, maintenance can be a matter of preventing injury and loss of life. To emphasize the importance of responsibly monitoring and maintaining technology, I will be researching the effects of proper and improper maintenance within the specific fields of web development and human use of outer space. This emphasis is important since if faults in a system or technology are not found and fixed, the consequences can be catastrophic.

In 2009, two communications satellites accidentally collided above Earth, sending thousands of pieces of debris from the wreck into orbit (The Dilemma of Space Debris, 2017). This space debris, among many other pieces generated in similar incidents, could have a disastrous effect on our use of satellites in orbit. Despite this threat, countries around the world continue the development and testing of technology that increases the amount of debris in space (Meyer). My STS research seeks to understand what social factors have influenced the technological developments that led to the increase in space debris, and how these social factors have also impacted the international effort to prevent the creation of more.

On a smaller scale, if a business's website has a slow response time, it will discourage users from trying to access the site and the business loses customers. For the web developer that

built this underperforming website, the drop in users could lead to a dissatisfied client and loss of both money and a solid business relationship. My technical project involves creating a simple way for a small web development firm to automatically monitor their hosted sites and ensure the maintenance of website performance.

Monitoring Web Applications: An Automated Approach

How can we develop an automated way to monitor the performance of web applications from scratch?

In 2021, Facebook had an outage for roughly six hours in which users could not access their websites. This brief loss of service cost the company an estimated $100 million, in addition to the loss of trust from many brands and services that rely on the platform to run (Huddleston Jr., n.d.). Although the scale might not be as grand, even for small companies the unsatisfactory performance of a website might mean a loss in customers, ad revenue, and more, in addition to the consideration of how much it costs to fix. For companies that outsource their IT services, it is imperative that the IT staff maintain the company's resources efficiently and without mistakes in order to maintain a satisfactory business relationship with the client.

After one too many angry phone calls from customers and weekends spent working overtime to fix a down website, software development firm Solution Street decided that its manual system of monitoring hosted web-based applications for performance issues such as downtime was inefficient, and they wanted to replace this system with a more streamlined automated process. As an intern, my team and I were tasked with creating a new application for Solution Street so that their teams can track the performance of their websites and be automatically alerted if there are any issues.

My team looked at available website monitoring services for ideas on what to include in our application. SolarWinds touted an existing tool, Pingdom, a paid service that offers page speed monitoring, uptime monitoring, and real-time text and email alerts as services (*Pingdom - Uptime, Website, & Performance Monitoring | SolarWinds*, n.d.). Another tool, Uptime Robot, offers SSL certificate monitoring in addition to uptime monitoring (*UptimeRobot*, n.d.). These available solutions to Solution Street's problem, in addition to many more on the market, were not adequate fixes for the company. They wanted something inexpensive, simple (without bloating of features that would go unused), and completely customizable for Solution Street's use. My team referenced these monitoring services to know what features are standard in a website monitoring application, so we could implement the important ones in our own application while still following Solution Street's requirements.

Overall, my team followed an Agile software development lifecycle, which included consistent meetings with our internal client to receive feedback on our work and adjust the requirements for the application going into the future. To start on the application, we had to design all the elements of it and receive approval from the client. We began by designing the user interface (UI), which involved producing prototypes of the UI to be reviewed by the client. In addition to the user-facing elements of the app, we also had to design the backend, which involved designing the database and deciding the relationships between database tables. After we completed the designs for the app, we went about implementing it. The framework we used for the overall application was Ruby on Rails, and we used frontend languages such as HTML, JavaScript, and CSS for the UI with PostgreSQL as our relational database management system. We added one major feature to the application at a time, conducting our own tests on it to make sure it worked before demonstrating its capabilities to the client to receive feedback.

As the internship concluded, we finished with a simple yet complete application that was able to monitor websites, keep statistics on uptime and speed, alert a user immediately if a website is having issues, and allow the user to customize what types of checks and with what bounds they want the app to perform. The app is in use at Solution Street today, improving the relationships the company has with its clients and allowing the development teams to monitor their websites with ease. As an intern on this project, I learned that the proper maintenance of the websites as a technology was able to save costs, time, and more positively impact stakeholders.

Space Junk: Factors Contributing to the Rise of Debris in Orbit

What social and political factors have contributed to the rise of space debris, and how have these factors led to the ineffectiveness of the Outer Space Treaty of 1967?

With the expansion of exploration and use of space over the past decades comes a similarly-growing problem: an increase in space debris, or "space junk." Space debris is made of remnants of human involvement in space, which includes broken-down satellites, discarded pieces of spacecraft, and more. Much of it is not detectable from Earth using current technology, so the growing rate of space debris entering into Earth's orbit may hinder both future space exploration and our current uses of satellites (Zannoni, 2022). Additionally, every new collision that occurs in orbit produces more debris, which then accelerates the rate at which the junk is created. According to a report by the United Nations' Inter-Agency Space Debris Coordination Committee, over the next 200 years the rate of so-called "catastrophic collisions" will increase to a rate of five to nine a year (The Dilemma of Space Debris, 2017). Analyzing this rise in space debris within a historical context with respect to the development of technology and international

tensions may help to understand why nations have a continued interest in allowing this problem to occur.

Background

The most significant agreement with regards to international use of outer space is the Outer Space Treaty of 1967, which has been signed by 109 countries and aims to establish guidelines for the peaceful use of outer space and space exploration (Ishola et al., 2021). Despite both the Soviet Union and the United States signing the treaty when it was first adopted (The Outer Space Treaty, n.d.), both nations began developing anti-satellite weaponry (ASAT) in the 1970s with the intention of being able to destroy observation satellites belonging to the other country (Bateman, 2022). The destruction of these satellites in space could potentially lead to an increase of space debris in orbit, but tests of ASAT still occur today. Significantly, in 2007 China tested an ASAT on their own satellite creating an estimated 30,000 new pieces of debris (Meyer). The United States, India, and Russia all conducted their own ASAT tests in years after.

Literature Review

According to Paul Meyer (2022), international tensions have contributed to the creation of space debris and ASAT technology, and a responsible way forward would be for nations to agree on a total ban of all ASAT weapons. However, there has to this date been no treaty regarding the creation of space debris. Diego Zannoni (2022) explains how the Outer Space Treaty of 1967 does not properly address space debris because it was not known to be an issue when the treaty was adopted. He makes the argument that there have been no effective ways to internationally be accountable for space debris, and that the 2019 Guidelines for the long-term sustainability of outer space activities adopted by the United Nations Committee on the Peaceful

Uses of Outer Space (UNCOPUOS) provides rules for limiting space debris, but no actual agreements made by any countries. Additionally, it has been argued that the Outer Space Treaty is ineffective in its entirety, because it does not provide an effective method of enforcing the rules it provides for the international use of outer space (Ishola et al., 2021). Although many sources that debate the effectiveness of the Outer Space Treaty exist, there is a lack of literature that explores why the treaty was written as it was, and why it has been interpreted in the way it has.

Evidence and Analysis

One part of my analysis will involve evaluating social and political conflicts around the time of the Outer Space Treaty of 1967 to determine how they may have contributed to the development of new technology such as ASAT. To do this, I will find accounts of societal fears and public opinion of the time that may explain why governments were interested in developing these technologies and allowing their continued use. These accounts may be found in newspaper articles (such as how national newspapers may frame other nations in stories), historical analyses in journals, and other reports that describe the political tensions of the time. In this case, the type of source is less important than the content, I simply want to find descriptions of these social and political tensions. The second part of my analysis will be connecting these historical accounts to the development of the Outer Space Treaty. I will read the Outer Space Treaty original document and consider the language of it, what nations participated in its development, and other aspects of it, as well as other analyses of the failures and successes of the Outer Space Treaty. I will analyze how the social and political factors I previously discussed may have led to the exact language used in the document, later interpretations of the document, and why nations may have

constructed the document the way they did in regards to the political factors and technological development.

Conclusion

For my STS research, I will place the development of space technology and the creation of the Outer Space Treaty of 1967 into the social context of the time. Through this lens I hope to gain insight on why the amount of debris in orbit first rose, and why it continues to rise to this day despite the Outer Space Treaty. For my technical project, I was introduced to the importance of real-world software maintenance. Through this work I learned the necessity of having a reliable way to monitor the performance of web applications. With the exploration of the ideas in both projects, I hope to emphasize the importance of monitoring and maintaining technology, both at an everyday scale and at a larger scale where the stakes may be higher.

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