Thesis Project Portfolio

Student Researched and Developed High Powered Rocket

(Technical Report)

Automation of Engineering Documentation

(STS Research Paper)

An Undergraduate Thesis

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Executive Summary

Engineering documentation is a critical part of advancement in the field of engineering. Documentation allows for communication of ideas, methods, insights, and work done pertaining to a project. This portfolio documents the methodology and results of two independent projects that both demonstrate the importance of documentation in engineering. The science, technology, and society (STS) project highlights the importance of documentation then discusses methods for implementing automation to reduce the time of documenting. The technical project highlights the need for documentation because it itself is an engineering design report. Inside the technical project is the description of the design of a small-scale rocket. Starting with explaining the design process for each component of the rocket then explaining prototypes created and lastly the technical report describes the testing of the individual components. At the beginning of the year the rocket capstone class was presented with the challenge of being the first team at the University of Virginia to design a rocket as a capstone project. Besides doing initial research and designing the rocket, the capstone class had to pass down all their research and design work to the next generation of students. Passing down this information required a series of different documentation from design and alternative ideas to risk analysis, to testing. For the reasons of passing down the project through documentation there is an apparent relation between the technical project and the STS project.

As previously stated, at the beginning of the year the rocket capstone team was presented with designing a rocket from scratch. To accomplish this task the following three teams were formed: Mechatronics, Propulsion, and Aero Structures. The mechatronics team oversaw designing a system capable of capturing all the data, storing the data, transmitting the live data to the ground, and picking the components of the payload. The propulsion team oversaw designing and fabricating the motor and the motor casing. Lastly the Aero Structures team was tasked with the fabrication and design of the body of the rocket using computational fluid dynamics and other stress analysis software. The portion of the technical project that was authored by the same author as the STS research paper is the mechatronics portion, specifically the avionics bay design. One of the individualistic tasks of the avionics bay was to work in conjunction with the electronics team inside of the mechatronics team to identify the necessary components that would be inside of the avionics bay. Additionally, the avionics bay design had to account for structural stability and account for blocking electro-magnetic interference. Due to time constraints a prototype was not able to be designed for the avionics bay. However, a section was created to give suggestions for designing and testing for a future avionics bay.

The STS research paper is aimed at answering if artificial intelligence can be used to automate engineering documentation and discussing implementation methods. The report uses the socio-technical systems theory as the framework to ensure that the solutions found for integration conform with the social systems established by the users of the automation. Early in the thesis prospectus it is shown how much time engineers spend creating documentation for engineering. Some types of this documentation are repetitive and take up a decent portion of the engineer's time. A case study from the medical field was used to analyze how the medical field is experimenting with their repetitive documentation. This study had found that artificial

intelligence is a viable solution to automate documentation if it conforms to the formats and desired length of notes. Using this idea the application of this to the engineering field was investigated. An engineering laboratory report and a handbook were dissected, and its content was discussed. It was found that engineering reports are hard to automate due to the creative nature of them using new procedures and having new designs. Certain portions of the documents can be automated if the information is on a database the AI can pull from. The downside of automation is investigated as well in the STS report. Cases from the past couple of years have shown that AI can mess up on document scanning. Another downside of AI is the implementation of AI into the department of defense in classified workspaces would require the AI have its own server and be fed information which would be a large undertaking for the government. It was concluded that as AI develops, it is possible if an engineer can give AI some information about their work and a format, then AI can create a decent portion of the engineer's documentation.

While working on both projects I was able to learn about theories about how engineering documentation could be automated, while actively going through a design process that an engineer would go through. The insight that received while working on the technical project allowed me to realize the difficulty of documenting the process of design, especially when brainstorming in a large group of people. This highlighted the need for an AI that can adapt to the engineering group's structure, because if the AI cannot then it would not be as useful as possible.