Lab Report Rhetorical Analysis

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ENGL21007: Technical Communication

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Household greywater treatment methods using natural materials and their hybrid system

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CAD-Base: An Attack Vector into the Electronics Supply Chain

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For this rhetorical analysis, I chose one paper in the Journal of Water and Health and another paper in the Association of Computing Machinery. The first paper: *Household greywater treatment methods using natural materials and their hybrid system*, discusses the use of natural materials in hybrid greywater (onsite recyclable water that does not contain fecal material) treatment systems which use both natural materials and membrane filters in their treatment process. The second paper: *CAD-Base: An Attack Vector into the Electronics Supply Chain* discusses various security vulnerabilities present in the Computer Aided Design circuit fabrication process. More specifically, The paper discusses vulnerabilities in computer systems that can be introduced during the fabrication of computer circuits thus providing access to the system not available in the original design. I will be analyzing the structure of the information presented in the two papers with respect to the analysis laid out in the important sections of chapter 19 of *Technical Communication, Twelfth Edition*. The important sections are: **title, abstract, introduction, materials and methods, results, discussion, conclusion, and references**. I picked these two papers as one is related to my field of study (Computer Engineering) and the other is the topic of research chosen for my final proposal (GreyWater systems as a solution to improving water sanitation in New York City). For discussion purposes, I will designate *Household greywater treatment methods using natural materials and their hybrid system* as **Paper one** and *CAD-Base: An Attack Vector into the Electronics Supply Chain* as **Paper two**.

Title

The title should be informative enough to enable readers to decide whether the paper has the information they are looking for or not. Furthermore, the title is to have terms that are commonly used by readers in the subject area (Markel et al, 2018, p520).

Paper One:

Household greywater treatment methods using natural materials and their hybrid system

This title does it's job well as it includes the terms that are central to the purpose of this paper: gray water, natural materials and hybrid systems. These reflect the major focus of the lab which is introducing readers to greywater treatment methods that utilize natural materials. Indeed it is one of the reasons that I found this paper and used it as a resource in my final proposal.

Paper Two:

CAD-Base: An Attack Vector into the Electronics Supply Chain

This title is very concise compared to the previous paper but it includes a lot more key terms that are central to the purpose of the paper as well as its subject area compared to the title of the first paper.

Abstract

The purpose of the abstract is to summarize the purpose of the paper and motivation behind the research, the results of the study, and finally the conclusions found by the study (Markel et al, 2018, p520).

Paper One:

Discharge of household greywater into water bodies can lead to an increase in contamination levels in terms of the reduction in dissolved oxygen resources and rapid bacterial growth. Therefore, the quality of greywater has to be improved before the disposal process. The present review aimed to present a hybrid treatment system for the greywater generated from households. The hybrid system comprised a primary stage (a natural filtration unit) with a bioreactor system as the secondary treatment combined with microalgae for greywater treatment, as well as the natural flocculation process. The review discussed the efficiency of each stage in the removal of elements and nutrients. The hybrid system reviewed here represented an effective solution for the remediation of household greywater.

This abstract states the motivation of the paper (line 1-line3) and also the purpose of the paper (line 3 - line 6). Finally we are given the results of the paper and conclusion in the remaining lines. Although it is short and concise, this is a good example of an informative abstract. My only criticism is that the paper does not include as many terms relevant to the subject area as the second paper does. This might mean the paper is not as technical as the second one or the audience is more broad than people working in the subject area.

Paper Two:

Fabless semiconductor companies design system-on-chips (SoC) by using third-party intellectual property (IP) cores and fabricate them in offshore, potentially untrustworthy foundries. Owing to the globally distributed electronics supply chain, security has emerged as a serious concern. In this article, we explore electronics computer-aided design (CAD) software as a threat vector that can be exploited to introduce vulnerabilities into the SoC. We show that all electronic CAD tools—high-level synthesis, logic synthesis, physical design, verification, test, and post-silicon validation—are potential threat vectors to different degrees. We have demonstrated CAD-based attacks on several benchmarks, including the commercial ARM Cortex M0 processor [1].

This paper does a good job of showing the motivation and purpose of this paper. It also has a lot of keywords that are relevant to the subject area of the paper. However, it does not list a clear conclusion and results section in the abstract. I think this is because the paper is not a conventional research paper that uses lab research and results to answer the research purpose and question but rather an exploration of the research topic. I believe this a good example of a descriptive abstract as compared to the informative abstract of the first paper.

Introduction

The purpose of the introduction is to provide a concise review of previous research relevant to the study and, depending on the audience, should also provide an explanation of theoretical background or specialized knowledge needed to understand the research paper. It should also provide the paper's significance in extending the research that has already been done in the subject area (Markel et al, 2018, p520).

Paper One:

 This paper does both in a good way, for example explaining the terms of the paper: *Greywater is wastewater discharged from showers, bathtubs, washing machines and kitchen sinks, while black water is toilet wastewater* , discussing previous research in the subject area - *Similarly, a study conducted by Wurochekke et al. (2014) revealed that the concentration of ammonium was 3.83 mg/L in household greywater. Domestic wastewater contains high concentrations of fecal indicator organisms, which range from 10^6 to 10^8 CFU/100 mL (Wilén et al. 2012). In terms of pathogenic organisms in the greywater, the concerns associated with the disposal of these wastes into the environment and natural water bodies lie in the ability of pathogens to survive and persist for a long time (Efaq et al. 2015). Pathogenic microorganisms have several mechanisms to survive in a stressed environment.* Finally is also shows how this paper extends the research done in the subject area and contributes new information - *The present review aimed to present a hybrid system consisting of three stages including filter media, a microalgae phycoremediation process and a flocculation process, to be used for the treatment of greywater resulting from village houses in developing countries. The hybrid system is proposed based on previous studies that investigated the efficiency of each stage in an individual work*

Paper Two:

This paper does not follow the conventional structure of the introduction that the previous paper follows. Instead of having one single introduction section, it breaks down the introduction into subparts*: 1 INTRODUCTION: 1.1 Computer Aided Design of Complex SoCs, 1.2 Risks of Modern Electronics Supply Chain, 1.3 Contributions of This Study,1.4 Paper Roadmap*. However, this format actually works really well because instead of having a really long introduction, all the needs of an introduction are explicitly laid out in the subsections outlined above. For example, extension of research in the subject area as well as the summary of results/ intended impact of the paper is provided in section 1.3, "Contributions of This Study" . The purpose of the research paper as well as some explanation of background information needed to understand the paper is provided in section 1.1 and 1.2 respectively. In fact, the paper also has a dedicated background section called *2 BACKGROUND* that goes into great detail explaining theoretical and technical background information needed in understanding the paper. Although it is unconventional with regard to the lab report writing template discussed in Chapter 19, this paper still does a really good job of meeting the needs an introduction should fulfill.

Materials and Methods

The materials and methods section of the paper is meant to convince the reader that the methods used in the study were credible in obtaining the results obtained thus also affecting the conclusion of the study. This section is also meant to ensure that the study has replicability therefore the methods and materials section must be detailed enough to ensure that other researchers can also conduct the study (Markel et al, 2018, p521)

Paper One:

This paper does not have a specific materials and methods section. The methods and materials of this paper come in the form of the paper detailing the methods and materials of the research cited to defend its proposal of a hybrid greywater treatment system. I believe due to the unconventional nature of this paper, it is not fair to criticize the paper for not having this section.

Paper Two:

The paper does not have a dedicated materials and methods section but it does present the results of its findings in a structured way following the order of the major trends presented. In section *4 CAD-INDUCED SECURITY VULNERABILITIES*, the paper presents some attack vectors (way of attacking a computer system through a vulnerability or way of introducing a security vulnerability in a computer system) that a CAD tool can be used for and in the section, the author briefly details how that vulnerability is implemented in the lab. Section *4.2 Malicious High-Level Synthesis*, is a good example of this:

We use Bambu [45] HLS tool to insert Trojans in benchmarks from the CHStone [46] and MachSuite [47]. These benchmarks are specified in C and represent third-party IPs that a designer may want to include in his/her design. We use these benchmarks to evaluate the backdoor attack, while the AES cryptographic benchmark is used to evaluate the FSM manipulation. Since a high-level description of the ARM Cortex processor in C, MATLAB, or any software language was not available, we could not use it for our HLS experiments. A set of 20 random inputs is applied for each design to generate the golden output values in software. Bambu is used to generate the corresponding Verilog descriptions and testbenches. These are then validated by comparing the simulation outputs with the golden ones. Next, the designs are

Trojaned using the malicious Bambu to add backdoor functionality that is activated with a predefined input sequence. When activated, the Trojan provides meaningful but wrong results as output, endangering the system where the components are used.

Despite the section not following the conventional method of implementing a singular materials and methods section with respect, I think the authors have actually well crafted this section as it makes reading as well finding information easier due to use of subparts.

Results

The purpose of the results section is to summarize the data relevant to the question or hypothesis discussed in the introduction. This is usually in the form of empirical or raw lab data. A good convention is for the data to be presented in the same order as the order the materials and methods discussed in the earlier section (Markel et al, 2018, p521)

Paper One:

Although this paper does not have a specific results section due to the nature of the paper, it does present research results from the sources it cites to defend its proposal. For example, the paper has a section discussing major trends in greywater treatment systems; more specifically data from a study showing the efficacy of a natural filtration greywater system to defend it proposed hybrid greywater system:

Greywater from kitchens contained much higher concentrations of organic substances, nitrogen, oil and grease, and detergents from the dishwashing processes. Mohamed et al. (2013c) showed

that the efficiency of the treatment system, which consisted of gravel, sand, peat and charcoal as treatment media to remove nutrients and organics in kitchen greywater, was 72% for SS, 37% for CODtot, 40% for BOD5, and 87% for . This signified that peat soil can also be among the potential materials used for the removal of pollutants. Hence, kitchen greywater can be treated with peat media. Furthermore, according to Table 1, TN removal varies from 5 to 98%, while phosphorus removal is observed in the range of 36–99.9%.

Paper Two:

The paper does not have a dedicated results section but it does present the results of its findings in a structured way. As stated earlier, the paper focuses on showing that attack vectors can be implemented via CAD tools. After a lab experiment using each vector, an *experimental results* section is provided. For example :

4.3.2 Experimental Results. We use SymbiYosys BMC [54], an open-source formal verification tool, to check properties of benchmarks from trust-hub and SymbiYosys website [54, 55] as well as the ARM Cortex M0 processor. We select Trojans that either leak the secret key or change the function. Furthermore, we select designs that include bugs that violate the design specifications. We embed security and safety properties in these benchmarks to detect malicious activities. We unroll each design for 5 clock cycles, which is large enough to detect any malicious activity in the given benchmarks, and run the BMC.

The results in Table 4 show that unrolling the design for 5 clock cycles can detect Trojans/bugs of the given benchmarks except the RISC processor. The verification team should unroll the design for >100 cycles to activate the Trojans embedded in it.

Table 4. Ability of a Bounded Model Checker to Detect Trojans for Different Number of Unrollings (n)

Benchmark	Trojan/bug effect	n = 5	n=4	n=3	n=2	n=1
		Detected/ Execution time (s)				
Memory	Modify Fun.	Yes/<1	Yes/<1	Yes/<1	No/<1	No/<1
AES-T800	Leak Info.	Yes/28	Yes/27	No/19	No/18	No/16
AES-T1100	Leak Info.	Yes/22	Yes/21	No/15	No/12	No/11
RISC-T300	Modify fun.	No/2	No/2	No/2	No/1	No/1
RISC-T400	Modify fun.	No/2	No/2	No/2	No/1	No/1
ARM_Cortex	Modify Fun.	Yes/47	Yes/47	No/27	No/24	No/22

In this respect, this paper is much better than Paper one as it has a structured results section(s). However, it does not follow the format presented in the textbook because each results section is but a component of a discussed attack vector and whereas the usual format is to have all the results in one section.

Discussion

The discussion section serves the purpose of interpreting the results that were obtained from running experiments in an analytical way. It serves to inform the reader whether the hypothesis was proven true or invalid per the data obtained from experiments conducted. It also serves to explain why produced lab results were true as well as note any issues the reader might have to know such as skewed data, and ambiguity of results (Markel et al, 2018, p522).

Paper One:

This paper does not have a discussion section

Paper Two:

This paper does not have a discussion section.

Conclusion

The conclusion serves to summarize the main points covered by the paper in one or two concise paragraphs as well summarize the most important implications of the findings of the paper (Markel et al, 2018, p522).

Paper One:

It can be concluded that the hybrid system (filtration unit, phycoremediation and flocculation processes) would be able to produce high quality treated greywater. The combination of primary and secondary processes is considered to be the most economical and feasible solution for GWT.

This paper has a dedicated conclusion paragraph that summarizes well the important aspects of the paper in a concise paragraph.

Paper Two:

Table 6 summarizes key takeaways of this study that reviewed an extensive set of attacks using CAD tools. All attacks are scalable. An attack is practical if it is easy to launch without collusion. An attack is stealthy if it is difficult to detect. HLS, verification, and PNR tools can introduce attacks that have high impact, as they can go undetected even within a commercial CAD flow. STA, test, and post-silicon validation tools can introduce vulnerabilities but require collusion with a malicious foundry. This minimizes impact. Logic synthesis attacks can be similarly detected by checks and balances in the design flow. One way to deal with malicious CAD tools is to use CAD tools from multiple vendors; design tools from one vendor and verification/validation tools from another.

Table 6. CAD-based Attacks: An Assessment Summary

Design stage	Practical	Stealthy	Impact
HLS	High	Yes	High
Verification	High	Yes	High
Logic Synthesis	High	No	Low
PNR	High	Yes	High
Static Timing Analysis	Low	Yes	Medium
Post-Silicon Validation	Low	Yes	Low
Manufacturing Testing	Low	Yes	Low

This paper has the better conclusion as it not only summarizes the main points of the paper in a concise and well put together paragraph but it also briefly expands on the paper by describing how discussed attack vectors can also be stopped without going into too much technical implementation detail (which is not the main focus of this paper). Even though ideally the conclusion should not introduce any new information or analysis to the reader (Markel et al, 2018, p523), I believe the inclusion of the table above aids in helping to conclude the paper.

<p style="text-align:center">References</p>

The reference section should list all the sources cited in the paper and also follow the appropriate documentation format/ system for that particular profession

Paper One:

This paper has an appropriate reference section that properly follows the reference format of the Water of Journal and Health Guidelines. The live paper also has links to the google scholar and publication history of the authors it cites which is also more helpful

Paper Two:

This paper also has an appropriate reference section that properly follows the reference format of the Association for Computing Machinery. The live paper also allows you to navigate from each reference to where it was cited

Appendixes

The appendix is usually the last component and it contains information that users do not necessarily need to understand the body of the lab report such as long tables of measurement, logs, and calculations (Markel et al, 2018, p523)

Paper One:

This paper does not have an appendix section

Paper Two:

This paper does have an appendix with subsections organized in the following format: *A FORMAL VERIFICATION TECHNIQUES, B EFFECTS OF CROSSTALK FAULTS, C STATISTICAL DELAY QUALITY LEVEL, D SIGNAL RESTORATION, E FAULT DROPPING ALGORITHM, F DESIGN FOR TEST (DFT)*

Each section goes into detail regarding a term that has been used in the body of the paper and also explains some algorithms and methods used in verifying a circuit that was designed and then later used for fabrication. The appendix makes good use of images and examples to make understanding of the topic being discussed easier and it also provides some extra resources that would provide more information on the topic discussed. This not only gives the reader further information related to the topic of the paper but it may also help people new to the subject area a better understanding of the context of the paper.

Bibliography

Basu, K., Saeed, S. M., Pilato, C., Ashraf, M., Nabeel, M. T., Chakrabarty, K., & Karri, R.

    (2019). CAD-Base: An Attack Vector into the Electronics Supply Chain. *ACM*

    Transactions on Design Automation of Electronic Systems, *24*(4), 1–30.

    https://doi.org/10.1145/3315574

Markel, M., & Selber, S. A. (2018). Technical communication. Bedford/St. Martin's.

Wurochekke, A. A., Mohamed, R. M., Al-Gheethi, A. A., Atiku, H., Amir, H. M., &

    Matias-Peralta, H. M. (2016). Household greywater treatment methods using natural

    materials and their hybrid system. *Journal of Water and Health*, *14*(6), 914–928.

    https://doi.org/10.2166/wh.2016.054