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Security Evaluation of a Biometric Authentication System

During the Spring semester of my freshman year in college, I submitted a research proposal to Lamar University's Office of Undergraduate Research. The proposal was accepted. Within a few months, I was set to carry out a major academic project in the summer of 2021. Prior to the time, I had no experience in elaborate research, so I approached the summer with a mixture of excitement, worry, and hope.

From the onset, I knew the major challenge I had was an insufficiency in knowledge. Related academic projects I had previously carried out revolved around collecting data from a population and then deducing facts from the statistics. This rarely ever tasked my knowledge; the information needed was usually a 'given'. But my summer 2021 research was established in an unfamiliar direction. I put forward a proposal to explore the vulnerabilities of a biometric authentication system. More so, my aim was to have results that would be contributory to the cybersecurity and Computer Science field at large. Similar projects had been carried out by individuals and organizations in the past, but the approach was usually based on exploitation methods from outside the biometric-enabled device. This approach almost always involved cloning/retrieving the actual fingerprint or other biometric of an authorized user. But my

intention was to exploit a biometric authentication system from within. I knew this would involve writing and understanding lines of code that were beyond my level of knowledge at the time, but for some good reason, most likely my passion, the challenge appealed to me.

Of course, the most visible asset I gained in the research period was knowledge. I ended the summer with more confidence in my knowledge than at the start of the summer. Also, given the task and the apparent *novelty* of the idea, I needed creativity to achieve the aim of the proposal. I had a clear idea of what I wanted to accomplish, but in addition to knowledge, there was need for a level of inventiveness on how to route the journey. This is certainly a skill I acquired as the summer unfolded: imagination. I am confident that I spent more time thinking about a way forward than I did working in the Computer Science laboratory – way more time. Most of the additional skills I gained are abstract but essential; two of them were patience and endurance. I specifically mention these two skills because we (I and my mentors) did not start making any real progress until mid- July. This was late for a project which had a runtime from June 2 – August 10.

Prior to the project, my career goal was well defined along the lines of cybersecurity, so I chose a research path that would complement this ambition. The research opened me up to the dynamics and intelligence involved in the field: hackers constantly find new methods of breaching system software; security experts continuously do the same but for the purpose of patching up perceived vulnerabilities in the software. The cycle is unending. This area of Computer Science demands a need to always learn and relearn; that was my experience in the summer. So overall, my undergraduate research reinforced my interest in cybersecurity.

Our research was not without results. Perhaps the most important result was that we were able to intercept the communication channel within a biometric authentication system and capture any information that would be transmitted at the instance of a user's authentication on a biometric-enabled device. This was essentially the breakthrough moment in our research. We strongly believe our finding can potentially unlock *any* biometrically locked device. After this finding, we encountered obstacles that prevented

us from making a full discovery and proving our belief. We would have set out to confront them, but time constrained us. We needed to:

- develop a filter to 'sieve' out irrelevant information that may have been captured, as not all the transmitted information would be related to the user's biometrics.
- develop a program to automatically store the captured information in a local file so that the information can be sent out anytime to unlock the same device.
- develop a program to send out the captured information in the same sequence it came in so that the information can be accepted by the device.

Several dynamics to the above have been omitted, as they are not explainable within two pages.

Summarily, the research was an enriching experience, academically and career-wise. As has been indicated already, a continuation of the project is possible, hopefully at a much higher level of my academic journey. I also plan to present the results of the research at the Texas STEM (Science, Technology, Engineering and Mathematics) conference coming up in Fall 2021 and at the Annual Undergraduate Research Expo at Lamar University in Spring 2022. My gratitude goes to my two mentors, Dr. Sujing Wang and Dr. Xingya Liu, as well as the Office of Undergraduate Research.