Thesis Project Portfolio

Block Chain Technology for Gun Reform: Evaluating the ATF's Database Challenges
(Technical Report)

The Facebook-Cambridge Analytica Scandal: Technological Politics and the Design of User Consent
(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Department of Computer Science

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Sociotechnical Synthesis

Emmie Halter – April 18, 2025 – STS 4600
Sociotechnical Synthesis

Designing Ethical Infrastructure: From Facebook's Failures to Blockchain Solutions

My STS research paper and technical capstone project, though addressing different subject areas, both examine how technological systems shape and reflect power dynamics, especially in regards to data collection and user consent. My capstone project focuses on using blockchain technology to modernize the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF)'s firearm tracking system. This system aims to enhance data security, streamline compliance, and support responsible gun ownership through an immutable, privacy-respecting digital registry. In parallel, my STS research paper investigates Facebook's role in the Cambridge Analytica scandal through the lens of Langdon Winner's "Technological Politics," exploring how Facebook's user interface design undermined informed consent and facilitated unethical data harvesting. Both projects critically engage with the ethics of digital systems: one exposing how poor design choices can erode autonomy, the other proposing how ethical design can build transparency and accountability.

The technical portion of my thesis centers on a blockchain-based solution to the ATF's outdated, paper-based gun sales documentation system. By creating a secure, permissioned ledger to record firearm transactions, the proposed system reduces the risk of illegal sales, increases traceability for law enforcement, and strengthens public trust. The project involves implementing smart contracts to automate compliance, integrating encrypted user data to balance privacy with accountability, and testing the system with a pilot network of licensed gun sellers. If proven successful, this design could be scaled nationally to standardize firearm tracking across the United States. The system leverages blockchain's decentralization and cryptographic security to solve a complex, politically sensitive public safety challenge without infringing on individual rights.

My STS paper examines how Facebook's design enabled the mass harvesting of user data by Cambridge Analytica. Using the framework of Technological Politics, I argue that Facebook's deceptive consent mechanisms, including vague privacy settings, default data sharing, and dark patterns, intentionally reinforced corporate power and limited user autonomy. The paper emphasizes how technical artifacts are not neutral; rather, they are embedded with political intent. This case demonstrates the societal consequences of unethical design and the importance of ensuring that user-facing technology protects, rather than exploits, its users.

Working on both projects simultaneously allowed me to explore technology's dual potential: it can just as easily reinforce unethical power structures as it can dismantle them. My research on Facebook's manipulative design practices made me more sensitive to how interface decisions and default settings influence user behavior, which directly informed my technical work in designing ethical defaults and transparency mechanisms into the blockchain interface. It also prompted deeper reflection on the responsibility engineers bear in shaping systems that are just, equitable, and respectful of individual autonomy. Moving forward, I intend to carry this

ethical perspective into future work in software engineering, prioritizing human-centered design and proactive consideration of sociotechnical impacts.