

Thesis Portfolio

Fleet Tracker
(Technical Report)

Ethics in the Self-Powered Internet of Things
(STS Research Paper)

An Undergraduate Thesis

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Author

Nojan Sheybani
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Sociotechnical Synthesis

The Internet of Things (IoT) is a wireless network of devices that exchange data in pursuit of common objectives, but the growth of this technology has been limited by the reliance of batteries as a power source. Historically, these devices have been battery-powered and have communicated through WiFi, Bluetooth, or cellular networks. However, traditional IoT devices face key challenges, such as the heavy maintenance burden of primary cell batteries and poor network infrastructures common to rural areas. A new field, called the self-powered IoT, has developed techniques to combat these issues. As more IoT systems adopt a self-powered approach, my STS research aims to study the reason for this shift towards the self-powered IoT and the ethical implications involved with this shift.

Solar energy harvesting and LoRa (long-range) modulation are among the self-powered IoT methods that can surpass limitations in reliability for the traditional IoT. Energy harvesting reduces battery-related maintenance, and LoRa modulation enables wireless communications despite weak pre-existing network infrastructures. For my senior design project, our team has designed and implemented a distributed self-powered IoT Global Positioning System (GPS) tracking system, called the Fleet Tracker, which uniquely uses both LoRa and solar energy harvesting. We used a variety of techniques to address some of the ethical implications of the self-powered IoT, such as reliable data transport, data security, and continuous operation in any environment. It was very important for us to address the social dimensions of our proposed technology because we were dealing with location data, which is very sensitive. We wanted to make sure that our technology was not putting our users' location data at any risk, as that could allow bad actors within the network to accurately locate users of our system.

My research will view the self-powered IoT through a sociotechnical lens. To be viewed as a sociotechnical system, the technology, structure, tasks, and actors must be defined, then the interaction of these elements must be analyzed. The self-powered IoT will then be evaluated using the normative framework of responsible innovation. To further my research, I will be conducting interviews with pioneers in the self-powered IoT. The outcomes of these interviews will be used to inform case studies to further answer my research question. I expect to find consistent reasoning for the shift towards the self-powered IoT and concrete examples of the ethical implications that are associated with the adoption of the self-powered IoT. When looking at my senior design's proposed technology and my STS research in concert, the shift towards the self-powered IoT is justified by allowing consistent and reliable data transport. The ethical implications, such as location data privacy, still need to be further researched.