

Thesis Project Portfolio

'Origami' Horn Antenna for Contactless Vital Sign Monitoring

(Technical Report)

A Cultural Analysis of the Geographic Constraints of Technological Innovation

(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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Spring, 2023

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Contactless vital sign detection offers a useful alternative when conventional methods, such as pulse oximeters, are not viable or optimal. Such cases could include a patient with severe burns, where electrodes or contacts cannot be properly attached, or when a patient is contagious and caregivers should limit exposure. Additionally, contactless detection can apply to situations where the target is obstructed, such as a survivor of a building collapse trapped beneath debris. Chest displacements caused by cardiopulmonary activity can be detected via radio detection, and horn antennas are optimal for this detection due to their directivity, allowing detection of subtle signal changes with minimal noise interference. Currently, commercially available horn antennas are expensive, usually made of machined brass plated in gold and costing up to \$5,000, and are available in few geometric varieties. These limitations restrain potential research and experimentation with a very promising technology comprising a wide range of applications and users. The capstone project seeks to address both of these issues by creating a UI that allows users to input desired geometry, and outputting a 2D template of a printable circuit board (PCB) antenna that can be 3D printed and folded into its final usable form. PCB fabrication can cost less than \$100 depending on the fabricator, allowing users to create something that is custom at a fraction of the cost of commercial manufacturers. Some social and human factors need to be taken into consideration. For instance, if used in a medical setting to monitor vitals, the antennas would need to function properly, delivering accurate data that could be used to determine what care is to be provided. The social construction theory of technology (SCOT) is easily applicable to this technology, as its relevant potential users such as law enforcement, medical staff, or emergency responders would require different forms of the technology to perform different tasks, which could yield a variety of different devices in the future. The loosely coupled STS research will primarily use actor network theory (ANT) to investigate the relationship between regional cultural attributes and technological innovation. The expected outcome of this research are factors that are associated with higher levels of technological innovation, which could potentially be implemented in schools or workplaces to promote innovation globally. On the technical side, the capstone work allows users to produce custom products at low cost that might not be commercially available for research and experimentation. The STS research seeks to broadly increase the extent to which all regions of the world are able to innovate. Although loosely related, the capstone and STS research in concert work to further democratize technological innovation.