Proof of Concept Proposal for *Mark A. Sternheimer Capstone Design Award*

**Project:** Computer Science 317 - Campus Bluetooth Tag Network

**Team Members:**

Nicholas Bennett, bennettna2@vcu.edu, 703-307-6677 **‒** Justin Yirka, yirkajk@vcu.edu, 703-229-7956 **‒** Jordan Mays-Rowland, maysrowlandjm@vcu.edu, 434-661-7842

**Faculty Adviser:** Eyuphan Bulut, Ph.D., ebulut@vcu.edu, 804-828-6382

This project seeks to design and implement a network of phones, and low-cost Bluetooth tags to assist members of the campus community in locating and retrieving lost items. Users will be supplied with lightweight Bluetooth Low Energy (BLE) [1] tags which they can attach to their possessions, including keys, computers, and bags. After registering their tags with either an iOS or Android app, a user’s phone will begin passively monitoring their items, recording the last known GPS locations of their items. If the user ever loses a tagged item, they may use their phone to recall the last known location. Further, using a *crowdGPS* model, the user will be notified if any other device in the network observes the location of their lost item.

These features are similar to existing closed-source models such as the *Tile* [2] and *TrackR* [3] systems. We improve upon current commercial alternatives by implementing security considerations to-date ignored by other tag networks. Research has suggested the importance of a decentralized model with an untrusted server, implementing cryptographic schemes which protect both user anonymity and security [4]. This project seeks to implement these academic security proposals in a commercially practical manner. In addition, this project will improve upon current commercial models by implementing customized static receivers throughout campus. In general, systems which depend on GPS location suffer indoors due to reduced signal accuracy. We will extend our system to include fixed receivers with precise awareness of their locations, such as the exact floor or room in a building, providing this information to users.

Finally, a goal of this project is to partner with the VCU Police Department (VCUPD) to provide useful features. Based on conversations with officers, we plan to provide a heat map of the campus, displaying areas which are not well-observed. Using this, VCUPD officers may patrol these areas, passively observing lost tags, digitally reporting their locations to the owners.

Our project suggests the immediate potential to partner with VCUPD to provide a low-cost customized service to the VCU community. These tags may be used by students and staff, and can easily be extended for tracking and recovering university property. This system can be open-sourced for use by other institutions. Commercial potential for this project exists in consulting for institutions which adopt this system, further customizing potential features.

[1] C. Gomez, J. Oller, and J. Paradells. Overview and evaluation of bluetooth low energy: An emerging low-power wireless technology. Sensors, 12(12):11734–11753, 2012.

[2] https://www.thetileapp.com/

[3] https://www.thetrackr.com/

[4] I. Agadakos, J. Polakis, and G. Portokalidis. Techu: Open and privacy-preserving crowdsourced GPS. In *Proceedings of MobiSys 2017*, pages 475–487, 2017.