SEMICONDUCTOR FAB PERSONNEL TRACKING

Team 1682 UTDesign II Fall 2023

Erik Jonsson
School of Engineering & Computer Science
The University of Texas at Dallas

Dorothy Bui (EE) dhb190001@utdallas.edu
Nahiyan Muzaffar (EE) nkm190002@utdallas.edu
Remy Nguyen (EE) rvn210000@utdallas.edu
Edy Gonzalez (EE) eag180005@utdallas.edu
Mitch Clark (CE) mrc190003@utdallas.edu
Bryce Canillo (CE) bcc190001@utdallas.edu

Faculty Mentor: Dr. Neal Skinner
Corporate Mentor: Dan Carothers
Sponsor: Strike Photonics

Background

Strike Photonics is looking for a method to track the location of personnel in their semiconductor fab. This system will be critical for life safety and process management procedures during equipment failure, gas leaks, or other emergencies that require evacuation.

Project Overview

Initial Approach

We initially approached this problem with UHF RFID technology using passive RFID tags and antennas. After extensive design and testing, it was concluded that this approach was unsuitable for addressing the requirements presented by the problem.

Current System Design

Our solution makes use of the DWM1001-DEV board from Qorvo, an UWB approach to location tracking. Each board can be individually configured to assume a certain role in the system either as a gateway, an anchor, or a tag. Tags are the units which personnel in the fab will carry with them on their body. The tags can also be individually configured to communicate at a selected frequency. Anchors are stationary units which communicate with tags in an area to determine the position of such tags in an area. A gateway is a configured DWM1001-DEV board that is mounted on to a Raspberry Pi 3B to extend the range of the system by communicating with other gateways and the host which serves as the primary connection point with the access at a computer.

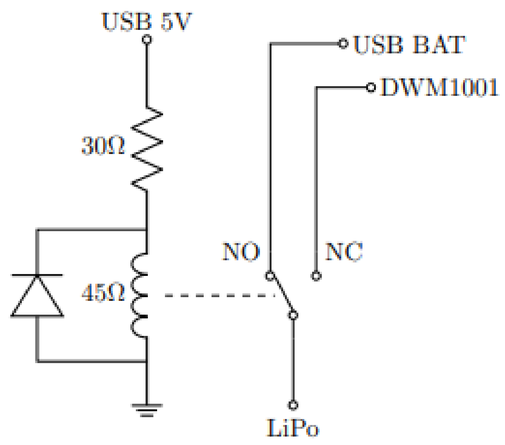

Figure 1. A circuit diagram of the power switching board.

Performance

- Minimum of 3 anchors must be able to communicate with a given tag
- Anchors have a maximum tested range of 42 feet
- In testing, tags were configured to communicate at an update rate of 10 Hz (reporting once every 100 ms)
  - Realistic implementation would require a lower update rate (e.g. 1 Hz) for a higher system capacity support 150 tags per network
- Observed ~33 hours of operation on battery and a 4.5 hour recharge time from 0%

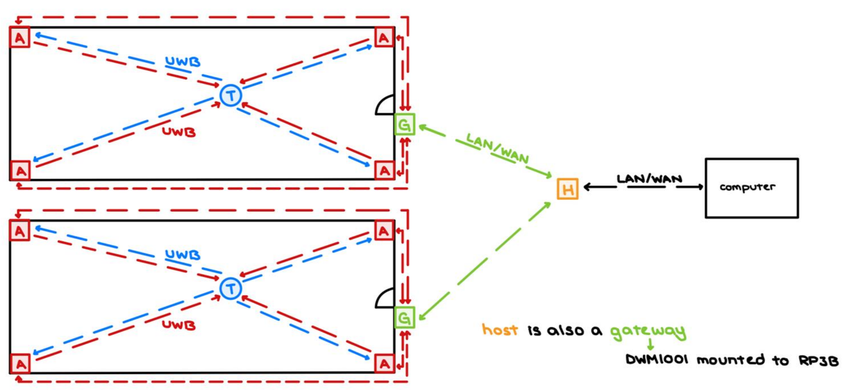

Figure 2. A simple diagram of the location tracking system.

Design Objectives

- Accurately track location of personnel inside the facility.
- Tags should last for at least 12 hours (full shift).
- Create a GUI that can access external servers and still function properly in the event of server disconnection, with a touch screen panel that is small enough to not interfere with other equipment but large enough to be visible with a mask on.
- Implement a way to record and access time-stamped location history

Results

- Users access a webpage using the IP address of the host gateway to see the display (as shown below)
  - Custom overlays can be uploaded for accurate mapping of the environment
- Gateways automatically scan for anchors and tags connected to the network
  - All units are listed for view
  - Additional configuration is also possible: naming, refresh rate, active/passive function

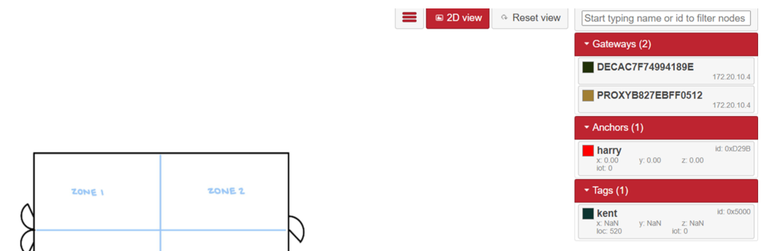

Figure 3. A screenshot of a webpage description automatically generated

- Gateways automatically publish position data from tags to a MQTT broker.
  - Python script pulls the information and stores the data locally in a .txt or .csv file.

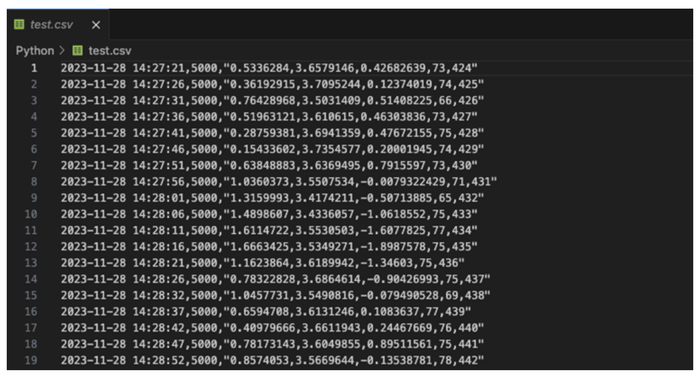

Figure 4. Screen capture sample .txt file recording the location data

Ethics Statement

We uphold ethical standards related to data privacy and transparency in our project. The collection of position data is intended for critical life safety management purposes and is not used to evaluate individuals' working performance. All components utilized in the project are at production standards, and only open source or properly licensed software was used in this project.

Conclusion

The system that results from this project has the potential to be an integral part of life safety management at Strike Photonics. It will also be capable of expanding to track non-personnel objects, such as wafers. The use of UWB technology and wireless communication allow for an effective real-time tracking solution.