OPERATING ROOM RFID INSTRUMENT TRACKING

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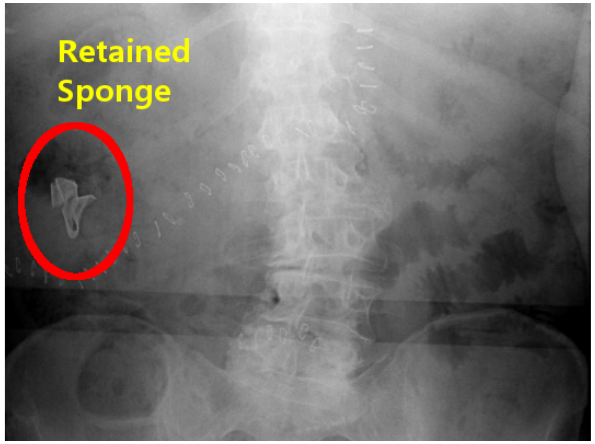
PROJECT OVERVIEW

Problem:

- Unnecessary instruments are delivered to the operating room
- Retained surgical instruments (over 4000 cases in 2018)
- Inefficient instrument inventory and sterilization

Solution:

- Use RFID tags to track and detect instrument use



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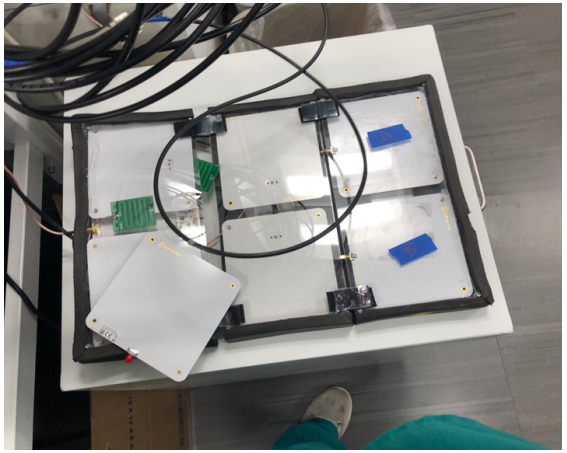
Unique Tag



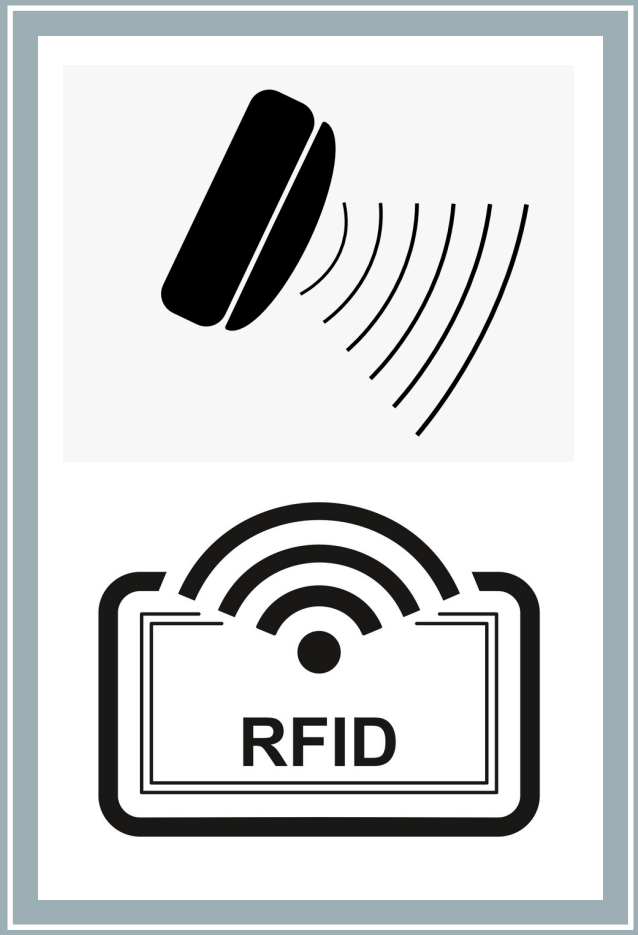
Antenna

Reader

HARDWARE

PILOT PROGRAM

- RFID tracking system tested at Duke University Hospital
  - Individual instruments given unique tag
  - Reader collects usage data
  - Data analyzed to help hospital optimize its workflow and safety
  - Tested for several specific surgical setups



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MY WORK

Goal:

Develop a new surgical antenna capable of being scaled across many surgeries regardless of setup

Throughout this process I followed the Stanford Bio Design Process as seen to the right

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NEEDS FINDING

Observed of 10 surgeries at Duke Hospital

- Recorded careful notes of surgical setup and patient positioning
- Interview physicians to find preferences and unmet needs
- Documented procedures

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CRITERIA: SCREENED BASED ON NEEDS FINDING

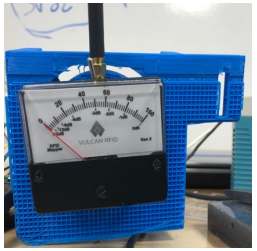
- **Durability**
- **Minimal Radiation**
- **Leave clear FOV for Surgeon**
- **Minimal Size (for designs that place antennas on patient:**
- **Accessibility**
- **Reliability**
- **Read Field / Accuracy (Performance)**
- **Sterilizable**
- **Use of Standard Parts**
- **Cost**
- **Stability**

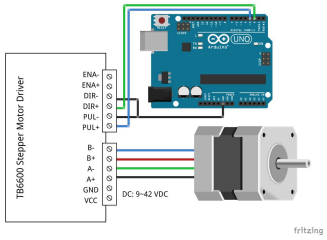
INVENT: PROTOTYPE DESIGN

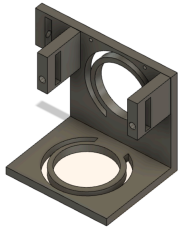
- Focused primary on patient safety, durability, and read-field/accuracy
  - Patient Safety: Used power mapper to ensure radiated power into the patient does not exceed 4 watts per kilogram (4 W/kg).
  - Read Accuracy: Use power mapper to identify antenna read field before running simulation to collect data.
  - Durability: Dropped design from 3, 4, 5, and 6 feet onto a tile floor and assessed the performance of the design before and after

SAFETY AND ACCURACY TESTING

- RFID power mapper was fastened to a 3D printed mount that can slide along a meter stick arm
- The arm is connected to a stepper motor that is powered by an AC to DC converter.
- An Arduino is connected to the stepper motor that controls the rotation of the stepper motor and records the voltage output from the power mapper
- Antenna placed at base of arm and the power of each antenna was mapped for 360°







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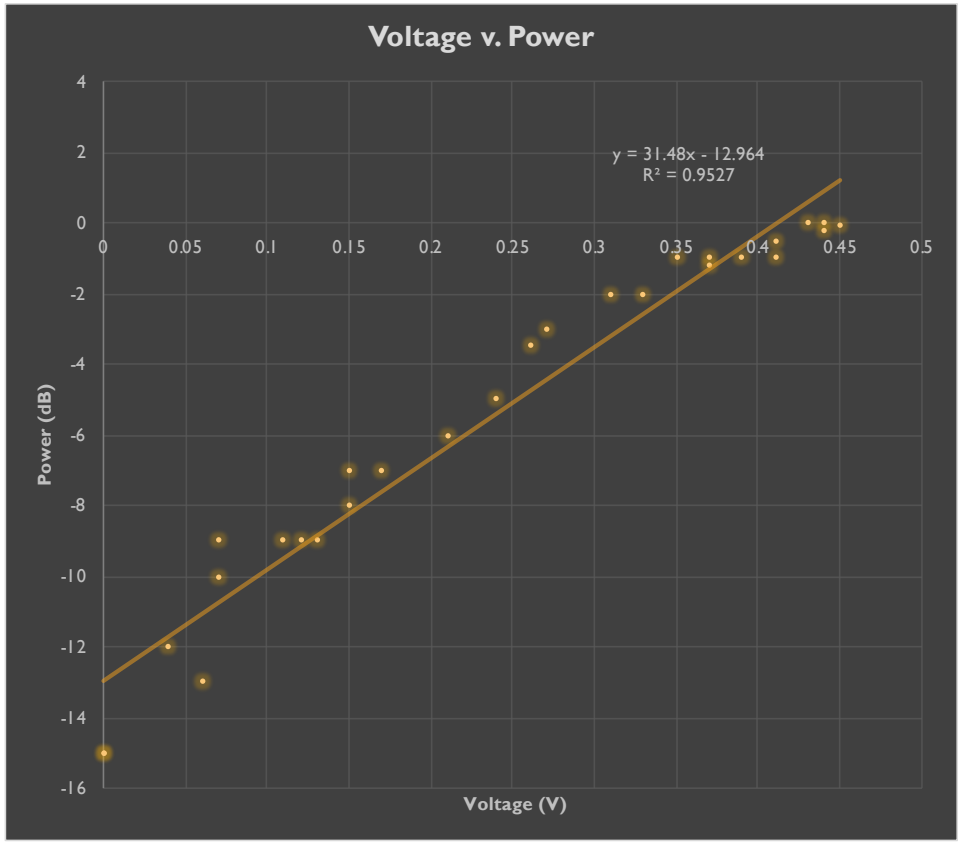

TESTING

Calibration curve used to convert voltage to power

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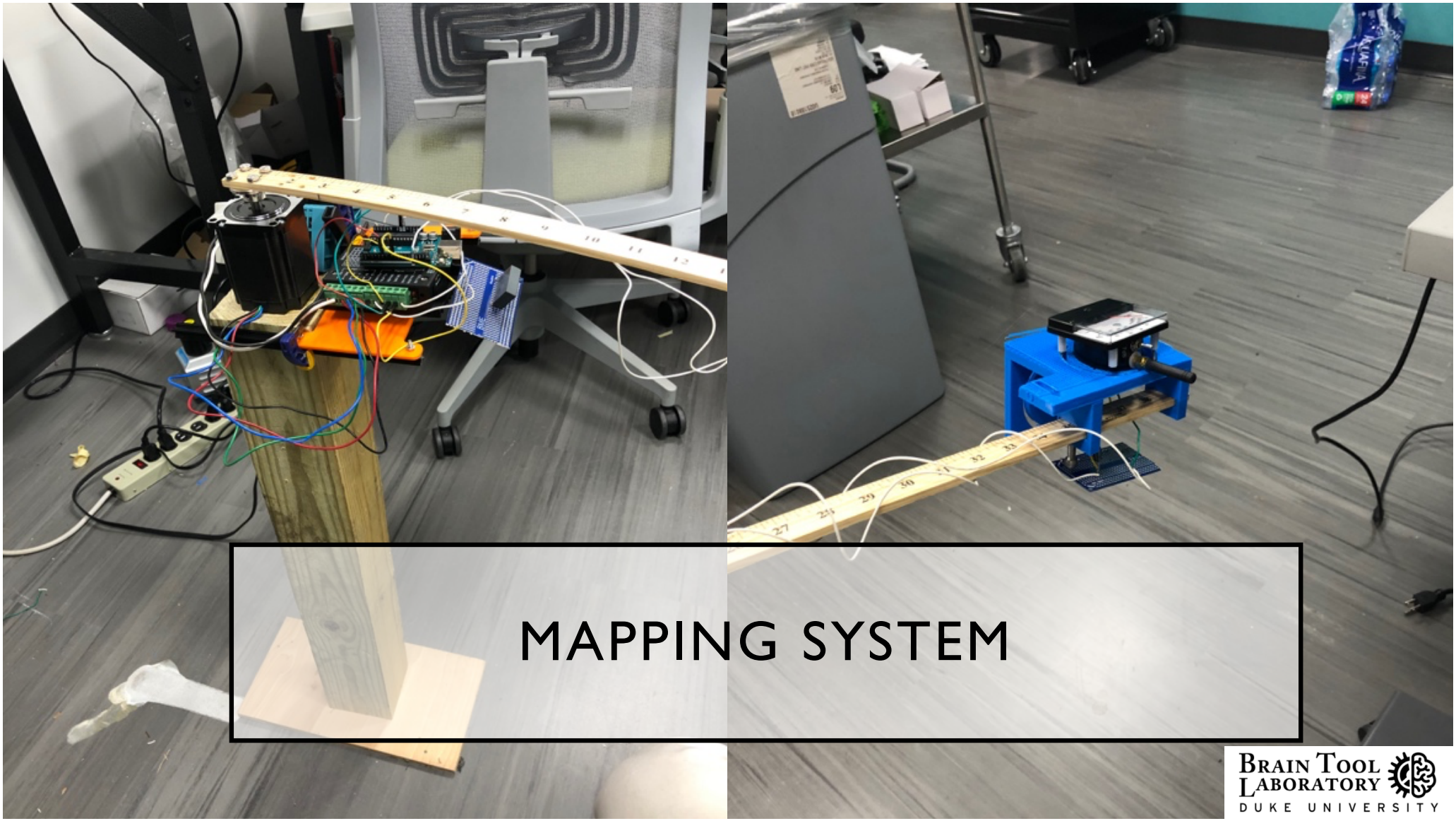

MAPPING SYSTEM

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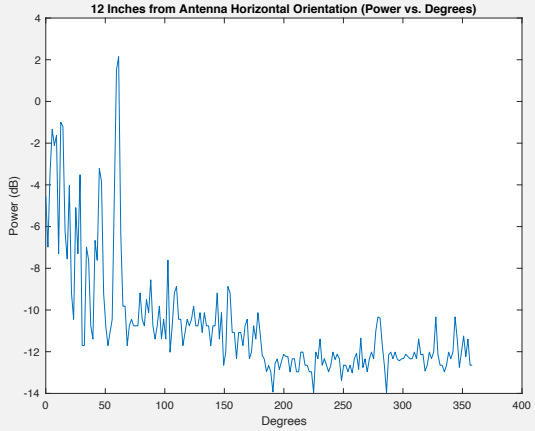

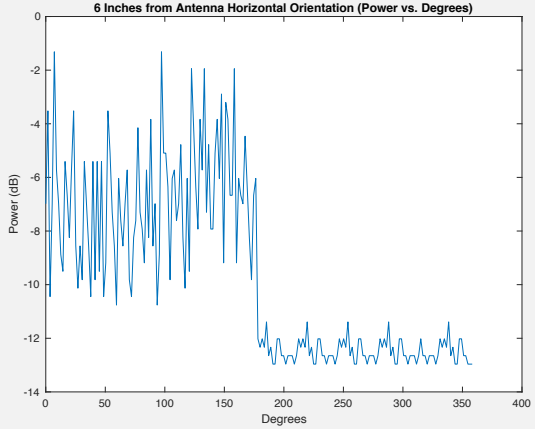

RESULTS

Results of power mapping tests for a single antenna

Demonstrates ability of antenna to read tags at various distances and angles

Significant noise in data – Could have resulted from other devices in the area or a problem with the sampling rate

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PROTOTYPE

Prototype Urethane Encased Antenna developed by Ian Hill

Mapped using this system:

- Met durability and safety requirements
- Further testing needed to determine performance in surgical testing

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IMPLEMENT: FUTURE WORK

- Further address noise in data and continue to map other antennas
- Implement each prototype into a mock surgery where a complete surgical setting is simulated as closely as possible and the RFID system and antenna are analyzed in their ability to meet all the outlined standards.
- If possible, the system will also be introduced into actual OR testing

  - These are steps that were being taken before the semester was prematurely ended