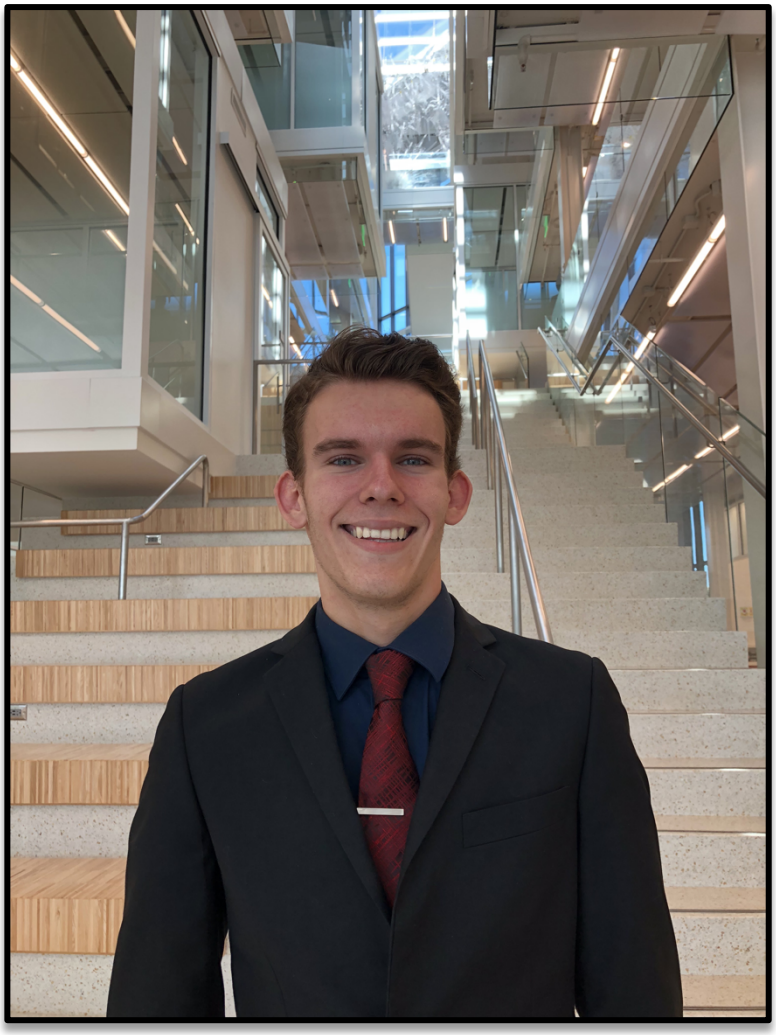

Anthony Tugman
Engineering Portfolio
awtugman@gmail.com

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Introduction

Hello there! I'm Anthony Tugman, an Intelligent Systems Engineering student at Indiana University Bloomington. After completing my B.S. in Intelligent Systems Engineering – Cyber Physical Systems in 2020, I continued my studies and will complete my M.S in Intelligent Systems Engineering – Cyber Physical Systems in May 2021. My academic and professional endeavors have developed both the skill set and professional background necessary to take a deep dive into developing cutting edge products upon graduation. With an interest in product development, my focus has revolved around rapid prototyping, hardware/software integration, PCB layout/design, and data visualization. I consider myself a "forever student", eager to both build on my academic foundations in the transition to a professional career as well as staying in tune with the latest developments in this discipline. I am a maker, a problem solver, and a creator; if a solution doesn't exist or the current solution can be improved I'm the first to take a try at it. This portfolio serves to supplement my resume and to provide greater insight into my background.

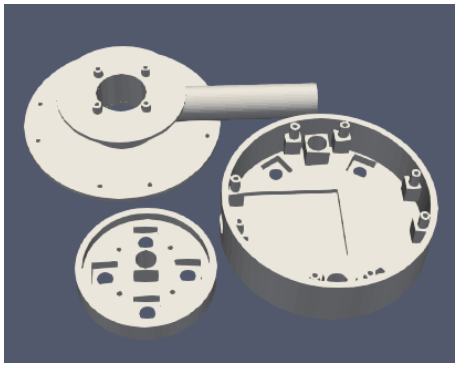
Lumis Corp

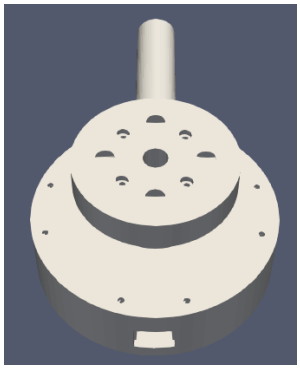
May 2020 – August 2020
Hardware/Software Integration Consultant

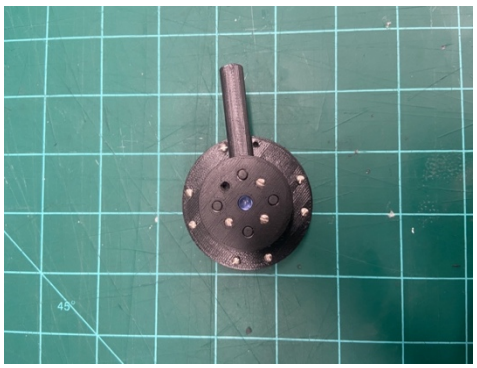
Lumis Corp is a healthcare education startup with the goal of providing automated, simulation-based training through the combination of augmented reality and fully standalone wearables. For the duration of my contract, Lumis was in a pilot-program testing phase, creating a need for modifications and developments to be made in real-time.

I was contracted to develop a demonstration ready prototype, acting as a proof of concept, for a training module being created to expand the current product lineup for a potential client of Lumis Corp. Following the strict design requirements set forth by the potential client, regarding size, cost, and functionality, I was able to successfully develop the prototype in 10 weeks' time. Through multiple meetings with my client, Lumis Corp, I was able to translate these requirements into 3D mockups ready for 3D printing. After the outer housing was approved, I began the process of designing the circuitry that would integrate with Lumis Corp's existing communication system for standalone wearables.

The device itself, a replica of a stethoscope, is intended for auscultation training. Lumis Corp's potential client, a medical school training program, indicated the most important functionality requirements included perception, in the sense that the device should perform and feel the same as training with a conventional stethoscope, as well as battery performance. I took special care to maximize battery size while maintaining the device size to that of a conventional stethoscope. Additionally, I kept the design simple so that the user would not have to change their behavior while using the training device. The design process was carefully documented with each step being explained in complete detail to maximize reproducibility. Documentation included 3D printing instructions, circuit diagrams, bill of materials, assembly instructions, and user instructions.







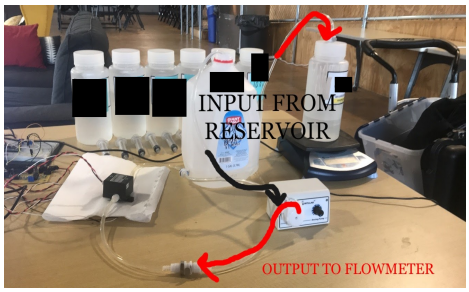
Lumis Corp

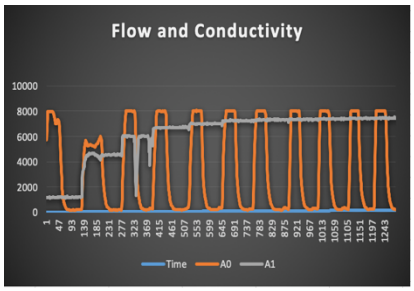
May 2019 – July 2019

Hardware/Software Integration Intern

Lumis Corp is a healthcare education startup with the goal of providing automated, simulation-based training through the combination of augmented reality and fully standalone wearables. With a wide range of potential users including nursing programs at universities, first responders, and medical teams worldwide, Lumis Corp aims to bring to market an adaptable, affordable, customizable platform that the competition cannot provide. Lumis is currently in a pilot-program testing phase, creating a need for modifications to be made real-time, and in house. During my time at Lumis, I took lead in these efforts of which included designing physical components for prototyping, determining a process for creating 3D scans of the beta system, as well as making improvements to the current beta system.

A request from multiple pilot programs was an increase in the number of recognizable drugs in the Drug Recognition System. The Drug Recognition System is a standalone wearable system that, when combined with augmented reality, provides a realistic experience of administering drugs to a patient and the accompanying physiological response. At the start of my internship the system was capable of distinguishing 5 simulated, injectable drugs, as well as the volume and speed of the injection. With the guidance of the company President I was able to convert the existing system to a new logic level, layout and analyze an updated computation circuit, generate a redesigned PCB, and create the accompanying documentation. Ultimately I increased the number of recognizable drugs to 10. Additionally, I designed an automated calibration system that allowed each additional Drug Recognition System made in house to be completed 80% faster. This process consisted of developing a standalone software module that communicated with my updated hardware design making it possible to calibrate a new Drug Recognition System without the need for making changes to the code of each system.





Photos Property of Lumis Corp

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Pittsburgh, PA 15213, USA
+1 (814) 573-7988

July 19, 2019

RE: Letter of Recommendation – Anthony Tugman

To Whom it May Concern:

I am writing this letter of recommendation to affirm that Anthony Tugman completed a summer engineering internship with Lumis. His internship with Lumis lasted from May 13th, 2019, through July 19th, 2019, and he completed about 400 work hours over this time.

Anthony has demonstrated his ability to adapt quickly to a new work environment and learn independently to make meaningful contributions to our engineering efforts. Over the course of his internship, Anthony worked on numerous projects involving hardware, software, and system integration. Some of his work involved automating our testing and calibration procedures, which will improve internal efficiencies. He demonstrated proficiency in CAD modeling and fabricated physical prototypes based upon his modeling. He also performed product and materials research to assist in our R&D efforts, and he was not afraid to pick up the phone and call manufacturers to expedite his research. Throughout all his work, Anthony demonstrated effective written and verbal communication. He created clear documentation of research findings, instructions for reproducibility of his work, and presentations of design alternatives.

Anthony also assisted with preparation and deployment for a product demonstration with a potential customer, which ultimately led to a sale. At the demonstration, Anthony learned how to engage with a potential client, give a product demonstration, and plan logistics for setup and teardown at a client's site.

Anthony has shown excitement and enthusiasm over the course of his internship, and he is always willing to learn more about how to improve our engineering efforts. Over the course of the internship, Anthony was able to communicate effectively and keep me apprised on all his work, despite my frequent travels for business development as CEO. Anthony also demonstrated the ability to work on a team, and to assist others when help was needed as our team grew throughout the summer.

Anthony has shown that he has the skills and determination to quickly learn about new tools, new technologies, and an industry that is new to him, and has demonstrated his ability to translate that knowledge into meaningful work-product. Anthony also exudes a high level of professionalism that translates well into business culture. I recommend Anthony for future employment opportunities, and I would be happy to further discuss his qualifications based upon this internship.

Sincerely,

Douglas A. Nelson Jr.
President & CEO, Lumis Corp.
doug.nelson@lumiscorp.com

Visualizing Anomalies in Veterinary Anatomy

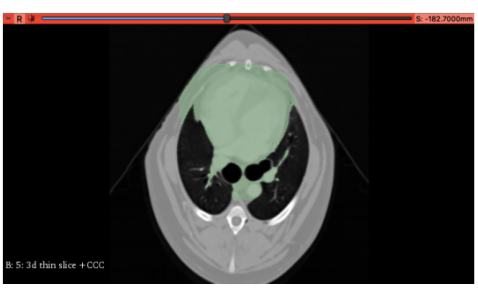
August 2020 – December 2020

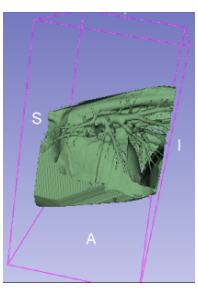
For *ENGR-E 584: Scientific Visualization*, I worked with Scott Birch, manager of Indiana University's Advanced Visualization lab, to identify anomalies in veterinary anatomy. Over the course of 10 weeks, Mr. Birch introduced multiple tools to me including 3D Slicer, Meshmixer, and Sketchfab.

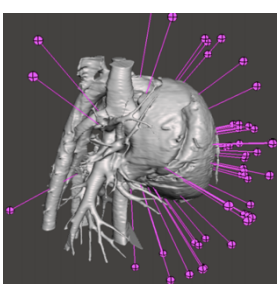
The primary audience for my visualizations was graduating veterinary students at Virginia Tech. As these students were nearing the end of their studies, they had advanced knowledge in the anatomical structures themselves. Therefore, I was not attempting to increase their technical knowledge through my visualizations, but rather providing them with an alternate way to view anomalies in the anatomy.

Mr. Birch provided me with a practical pipeline for analyzing, manipulating, and presenting the anatomy contained within CT scans. To begin, 3D slicer was used to comb through the vast CT datasets to identify and remove the relevant anatomy. For my presentation the relevant anatomy was a canine heart. After the target anatomy is removed and converted into a 3D model through software, it is exported to Meshmixer for manipulation. In Meshmixer I was able to remove any unnecessary artifacts in the 3D model, clean up defects within the model, and manipulate the files needed to present the model itself. Finally, I imported the "cleaned" model into Sketchfab where I prepared it for the final presentation. Sketchfab allowed me to convey my story through the model itself by adding lighting, coloring, and annotations that the veterinary students could interact with to quickly identify the defect and visualize it in three dimensions rather than that of a typical two dimensional CT scan.

I feel that this project is relevant to include in my portfolio as it demonstrates my ability to quickly and effectively adapt to new software and concepts that I have no familiarity with while successfully generating a presentable final product.





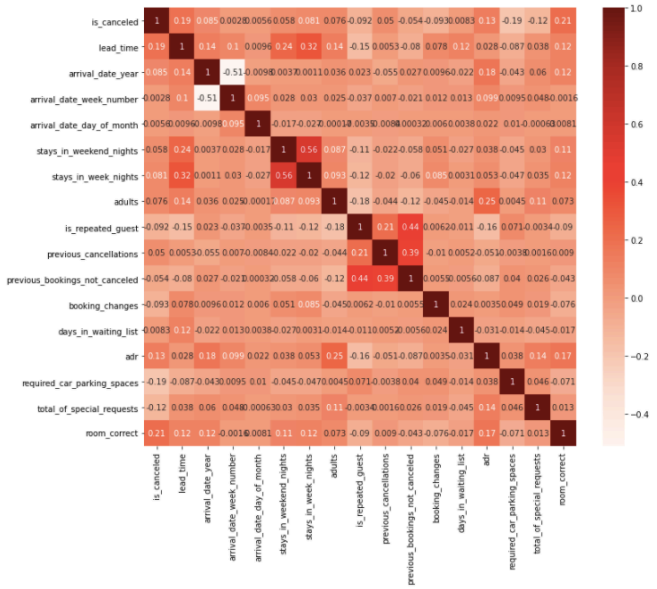


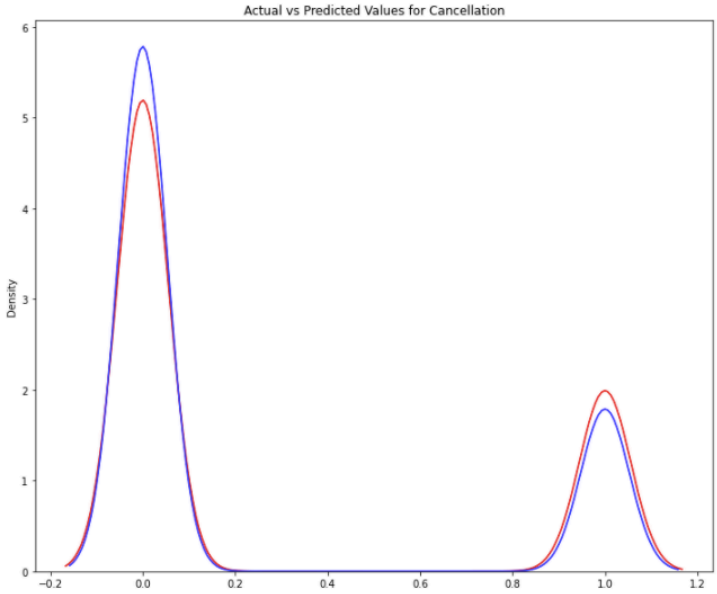
Predicting Hotel Reservation Cancellation Rates

August 2020 – December 2020

For *ENGR-E 584: Big Data Applications*, I was tasked with developing a Python module to analyze data in a meaningful way for real-world application. With Covid-19 ravishing the hospitality industry, I chose to focus on hotel cancellation rates. Unlike other categories in the hospitality industry, lodging facilities typically allow guests to cancel a reservation just 24 hours in advance of their stay. Many lodging locations are currently short-staffed and the bottom line is now razor-thin highlighting the need to able to effectively predict how likely a guest is to cancel.

To accomplish this, I acquired a large, anatomized dataset of various factors an unidentified hotel chain tracks in regards to their guest's reservations. In pre-processing the dataset I was able to remove data points that were unnecessary as well as those that would hinder the generation of a predictive model. 32 attributes were analyzed to determine the strength of their correlation to the successful completion of a reservation. To trim down the processing power needed, and to ensure that a standard computer used at hotels could be used to run my model, I removed the attributes that did not have a significant correlation. The remaining attributes were used to generate a Random Forest predictive model, and multiple tests were conducted to determine the most effective split between training and test data. Ultimately, I was able to create a model with approximately 77% accuracy which, if implemented by hotel chains, has the potential to make a significant difference to the bottom line. My full write-up can be found at: https://cybertraining-dsc.github.io/report/fa20-523-323/project/project/





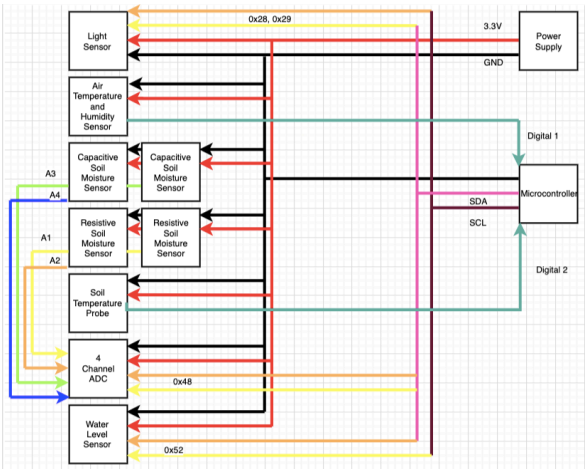
IntelliPlants

August 2019 – May 2020
Hardware Integrator

For *ENGR-E 490: Engineering Capstone Design*, I was part of a 5 person team working to develop a desktop automated greenhouse. IntelliPlants was intended to be developed from an idea to a demonstration ready prototype however Covid-19 caused much of our work to be conceptual.

I was personally responsible for the design and integration of the sensor array which would provide automation for temperature, humidity, soil moisture, light exposure, and nutrient dosing removing the need for the user to intervene in their journey to growing hardy, pesticide-free crops. This process involved hand-picking individual components, checking for compatibility, integrating components with the other modules, developing schematics for component integration, and documenting the process. Additionally, I took responsibility for creating a power supply for our system as well as the external housing that would hold all components and prevent damage that may be caused by the combination of liquid aspects and sensitive electronics.

This capstone project was a test of the culmination of knowledge and experience I developed in my undergrad studies and gave me a full view of the product design process as a whole. Aside from my direct engineering responsibilities, I also managed patent infringement research, consulting with experts in horticulture, meeting various engineering standards, and facing rigorous design review. I reinforced my ability to be an expert in my area of work while being able to communicate effectively both across members of my team as well as with those of varying degrees of technical knowledge.



Light Monitoring System – Indiana DNR

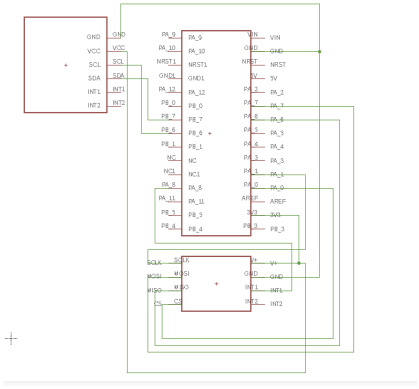
January 2018 – May 2018

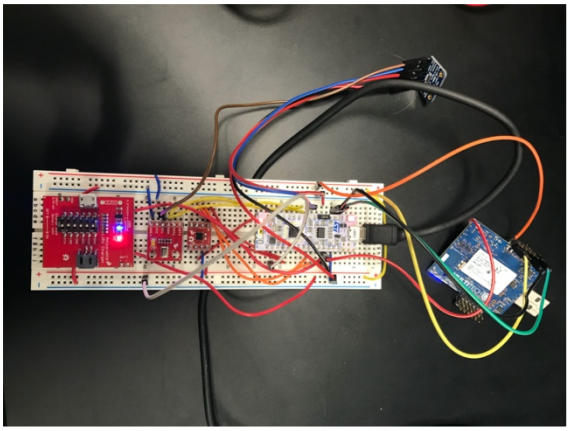
Embedded Systems Designer

For *ENGR-E 210: Engineering Cyber Physical Systems*, the semester project was to create a system that the Indiana Department of Natural Resources could use to measure trail activity and light pollution within the state forests. This system needed to be low power, have wireless communication, and require minimal maintenance once deployed. With the cross-disciplinary help of my partner, a CS student, we were able to prototype such a system.

The major constraint in the system development was budget, which caused me to have to make choices across the various components to find the best balance between cost and longevity. I was personally responsible for sensor selection, debugging the hardware of the prototype, and monitoring power consumption. The size of the LiPo battery was the most impactful decision as a larger battery would allow for a longer life, but also affected the budget. To minimize power consumption, I analyzed the datasheets of each component to decide how best to accomplish this through hardware. My partner was then responsible for making these changes in the software.

The device consists of a Nucleo microcontroller, a pressure sensor, a light sensor, a LiPo battery and charger, and a LoRa radio module for data transmission. A partial schematic for the system is shown. Learning how to create a schematic for the system was confusing, yet useful, as it showed me the steps necessary to turn a mess of wires into a final product. Through this project I developed an appreciation for the complexity of PCBs and came to the realization that there are many more factors that must be taken into consideration apart from component placement.





Improving Maker Technology for Aging Adults

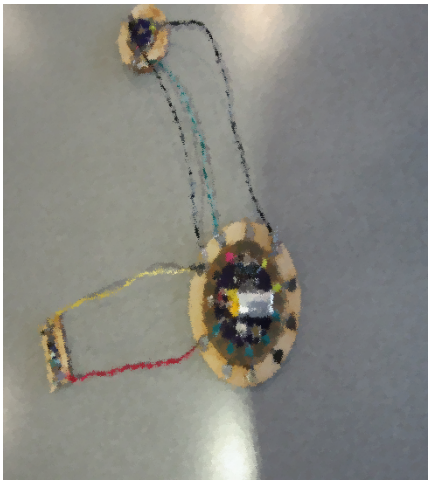
August 2017 – December 2017
Undergraduate Researcher

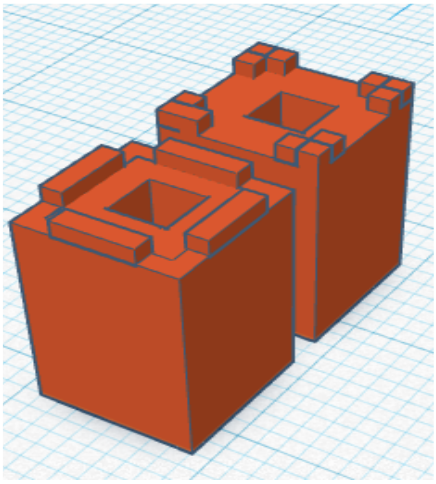
Determined to do research outside of my coursework, I joined a team of National Science Foundation sponsored Indiana University Pro Health researchers. These researchers were working to develop a "toolkit" for aging adults to learn to use simple circuits to adopt into crafting projects. When I joined, the toolkit had been developed and user tested, however design flaws had been exposed.

The original toolkit used magnets to form circuit connections. During user studies, the magnets proved to be simple to use, intuitive, and provided a secure connection. However, many of the users were inadvertently creating short circuits. This caused the magnets to lose their strength, even if connected incorrectly for only seconds. Also, this form of connection required excellent coordination which many of the users did not possess.

After considering using jewelry snaps, I decided these components were to small and would not provide a satisfactory experience for the user. Using 3D printed connectors seemed like a more viable solution. Using CAD software, I went through multiple iterations of the connector before I arrived at a final solution.

My design solved the flaws of the previous toolkit as it was easy to manipulate, only fit together one way preventing short circuits, and were color coordinated to help develop an understanding of circuit polarity. At the completion of the semester the newly designed toolkit was proceeding for further user testing.





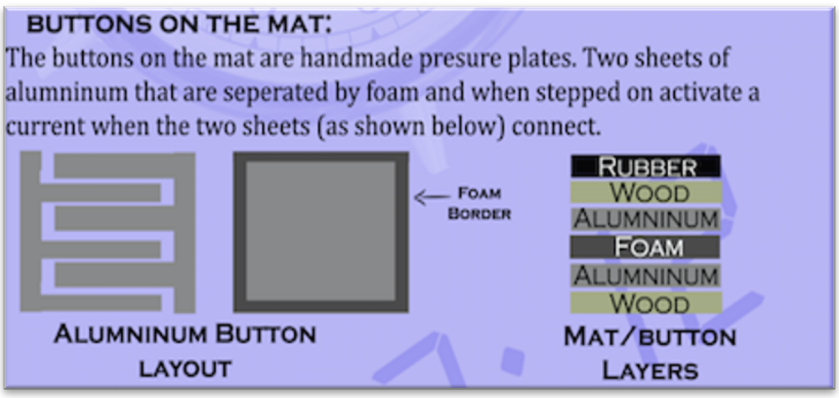
Alarm Mat

August 2017 – December 2017
Project Manager

For *ENGR-E 101: Innovation and Design,* I lead a team of three undergraduate students tasked with creating a device to "improve lives using technology" We decided to create an Alarm Mat, a device that incorporated mental and physical activity with an alarm clock to make the user get out of bed to stop the alarm rather than hitting 'snooze' and falling back asleep. Over the course of approximately 10 weeks we went from prototype to a demonstration ready prototype.

The prototyping phase was used for proof of concept, to illustrate that a pattern-entering system could be used to wake up the mind and trigger an alarm to stop. When beta testing the prototype I realized that using the same pattern each time was ineffective as the user would quickly memorize the needed pattern. As a solution, the pattern was randomly generated for each use.

Along with leading the team and maintaining our schedule, I was tasked with the construction of the final device. I encountered the problem of sensing the user's presence on the device without implementing an expensive pressure sensor. To solve this problem, I created a makeshift pressure sensor as shown in the diagram below. After countless hours of trial and error and beta testing with users of different body types, I was able to determine the proper sensitivity to sense users of all body types. In addition, I designed the final 3D printed enclosure shown below, that housed all of the wiring components.



Anthony W. Tugman

awtugman@gmail.com | (219) 902-3832 | atugman555.github.io/projectportfolio

EDUCATION

Indiana University Bloomington — Bloomington, IN

M.S. Intelligent Systems Engineering – Cyber-Physical Systems — May 2021
B.S. Intelligent Systems Engineering – Cyber-Physical Systems — May 2020

EXPERIENCE

The Laser Agent — Noblesville, IN
Hardware Test Engineer — March 2021 – Current

- Evaluated medical lasers for repair while producing documentation to streamline processes in future
- Created novel solutions to diagnosing and repairing complex electrical systems with repeatability
- Increased service revenue 50% by contributing to engineering efforts and managing customer accounts

Lumis Corp — Pittsburgh, PA
Hardware/Software Integration Consultant — May 2020 – August 2020

- Collaborated with client to determine product design requirements, functionality, and budget
- Modeled device using CAD and circuit simulator to ensure client's needs were met before assembly
- Created a demonstration-ready prototype in 10 weeks' time, from concept to physical device, including accompanying documentation (bill of materials, wiring schematic, assembly guide, instruction manual)
- Generated a virtual simulation in Unity 3D to demonstrate to client how the device is intended to work when integrated with the existing communication protocol

Hardware/Software Integration Intern — May 2019 – July 2019

- Facilitated R&D efforts by leading product and materials research, prototyping mechanical components, and presenting marketability findings on design alternatives as additional customers were acquired
- Redesigned an existing wearable module to meet customers' needs including upgrading microcontroller and associated hardware components, wiring schematics, PCB, software, and technical documentation
- Automated debugging, testing, and calibration procedures reducing module deployment time by 80%

ACADEMIC PROJECTS AND RESEARCH

IntelliPlants – Automated Greenhouse System — Bloomington, IN
Hardware Integrator — August 2019 – May 2020

- Designed, fabricated, and assembled a robust device housing to safely partition sensor array from grow area as well as preventing water delivery components from coming into contact with sensor array
- Selected and verified each hardware component to ensure compatibility and performance
- Generated technical documentation including specifications, IEEE standard fulfillment, analysis of simulations, and proof-of-concept results before presenting to a board of industry experts for review

Light Monitoring System for Indiana DNR — Bloomington, IN
Embedded Systems Designer — January 2018 – May 2018

- Designed a prototype conforming to customer requirements including cost, weatherability, and ease of use by selecting components, generating a schematic, and fabricating a weatherproof housing
- Verified performance through data logging, power analysis, and in-field deployment
- Collaborated with a multidisciplinary team to refine device's power consumption through software

TECHNICAL SKILLS

- **Languages:** Python, Verilog, Arduino, C, C++, C#
- **Software:** EAGLE, SolidWorks, Fusion 360, Unity 3D, Git, Linux
- **Lab:** Component Selection/Assembly, Soldering, Oscilloscope, Function Generator, 3D Printing, Laser Cutting, CNC, CAD Modeling, PCB Design