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S1: Main Paper Session

Chair: Gregory Durgin (Georgia Tech, USA)

Indoor localization has become increasingly necessary for military and first response operations. However, since current GPS technology has rather low accuracy and reliability in indoor spaces, Ultra-Wideband (UWB) radio is a popular, more accurate alternative for indoor localization. This paper focuses on using UWB localization paired with inertial-based dead reckoning algorithms for more accurate and reliable tracking and navigation in indoor environments. Multiple UWB anchors are placed within a building and communicate within the anchor network, while the UWB tag on the robot overhears the communication and locates itself within the building using Time Difference of Arrival (TDoA) calculations. The robot is also equipped with an inertial measurement unit (IMU) that uses the accelerometer and gyroscope data in conjunction with dead reckoning algorithms and Kalman filtering to help the Roomba generate location estimates to achieve a higher update rate and reduce uncertainty in "dead zones" where the UWB signals are insufficient for the Roomba to use in its TDoA calculations. Together with a path planner module and feedback controller, the robot can generate and follow a certain trajectory. With the proposed solution, several experiments with different programmed paths will be performed. These experiments are expected to show that the robot navigates within 10 cm of its planned trajectory.

discoveries of a third photoreceptor in the eye have shown a need for a new application in smart lighting called circadian lighting. Years of not delivering adequate light energy to this circadian photoreceptor have shown connections to fatigue, tiredness, depression, and disruption of one's circadian rhythm. However, the lack of standardization in the lighting industry has made it both difficult and expensive for current companies to make the change to this new developing lighting system.

This research aims to develop a lighting system that can increase the health effects of today's lighting while continuing to increase efficiency and adjustability in a cost-effective manner. Utilizing the low-cost option of 3D printing for the hardware allows for rapid testing during the development phase and easy customization for the end users' needs after deployment. In addition, creating open-source software with already existing systems like the Arduino IDE makes upgrading one's current lighting systems possible without running into proprietary issues.

Moving the state of lighting to one that is highly customizable and open source allows for democratized technology. This way lighting is more accessible to the user and their needs as each end user will likely have different needs. Studies have found that individuals working under their preferred lighting conditions had increases in mood and ratings in terms of lighting and environmental satisfaction.

Hoseon Lee, NIck Garber, Sravani Ambadapudi, Michael Nolan and Joseph Lee (Kennesaw State University, USA); Fang-Chen Lin (Aimtec, USA); Peter Hesketh (Georgia Institute of Technology, USA)

This paper is on developing three-dimensional micro-solenoids with channels through which magnetically tagged antibodies can flow through for the purposes of antibody detection for viral infections. A COMSOL simulation study has been conducted and a 3D-printed micro-coil winding apparatus has been designed and fabricated for automating the coil-winding process. An ultra low-noise amplifier circuit is simulated, prototyped and tested for the purpose of amplifying the induced voltages from the micro-solenoid when a magnetically tagged antibody passes through.

Sahil J Mithani and Juntao Wang (Georgia Institute of Technology, USA); Zeinabou Diarra and David Lin (Georgia Tech, USA); Omer T Inan (Georgia Institute of Technology, USA)

Treatments for Single Ventricle Diseases (SVD) involve risky surgeries and can still result in hospital readmission, making continuous wearable monitoring systems to detect clinical deterioration and improve patient outcomes extremely valuable. The seismocardiogram (SCG), a non-invasively acquired cardiomechanical signal, contains features that provide critical heart mechanic insights and can be used in conjunction with existing wearable signal modalities to improve SVD patient outcomes. However, the exact relationship between SCG features and cardiac behavior has not been thoroughly studied. While modeling heart movements has increased SCG understanding, much of the previous work has only used canine and adult human hearts. As such modeling, the hearts of patients with SVD are not well understood. In this work, we created 3D models of the infant's heart and developed a modeling pipeline to compare the acquired SCG signals to those created by simulation models. The result indicates accurate segmentations of the aortic root, ventricles, and atria, and a FEM analysis on a ventricle heart model is established to be a useful starting point for hydraulic forces analysis on heart models. Modeling heart movement for SVD patients can provide a deeper understanding of SCG signals in identifying specific SCG characteristics in SVD patients for monitoring applications.