Libo **Wu**

Embedded System Development

180 Spence St., College Station, TX 77840, USA

(+1) 631-538-8815 | libo.wu@tamu.edu | libowu.com | libowu | Libo Wu

Summary

- Proficient in embedded system design, hardware integration, embedded software development, sensor technologies & applications for smart home devices, and indoor occupancy detection.
- Strong skills with machine learning, PCB design, wireless communication, circuit design, and signal processing.
- Hand-on experiences in 3-D CAD modeling, product design, and troubleshooting.
- Seeking for internship/full-time positions in 2020 in embedded system design and system engineering.

Education

Texas A&M University — *College Station, TX, USA*

Ph.D. Candidate in Mechanical Engineering (Transfer Student) — *Aug. 2018 - Dec. 2020*

Stony Brook University — *Stony Brook, NY, USA*

Ph.D. Candidate in Electrical and Computer Engineering — *Aug. 2015 - Jul. 2018*

University of Science and Technology of China — *Hefei, Anhui, China*

B.S. in Applied Physics — *Aug. 2011 - Jun. 2015*

Skills

Programming	Embedded C, Python, C/C++, Matlab, Assembler, LaTeX
Technical Skills	ARM Cortex-M Micro-controller driver & application development, RTOS, SolidWorks, Machine learning, Machine learning frameworks (Tensorflow, Keras), Labview, PCB design, Circuit design

Experience

Liquid Crystal Optical Shutter on Passive Infrared Sensor for True Presence Detection — *College Station, TX, USA*

Research Assistant, Advisor: Dr. Ya Wang — *Aug. 2018 - Present*

- Solved the issue that motions sensors (PIR sensors) could not detect stationary occupants.
- Created a liquid crystal (LC) infrared shutter that can modulate long-wave infrared radiation with low driving voltage and ultra low power consumption (4.8V driving voltage with $<$10nA).
- Manufactured Polymer Dispersed Liquid Crystal (PDLC) infrared shutter with 8% modulation degree.
- Developed a synchronized low-energy electronically-chopped PIR sensor for true presence detection by applied the created LC shutter to a PIR sensor packaged in an extremely low power embedded system ($\sim 20\mu$W) [patent pending].
- Conducted experiments for presence detection. Reached 99.8% accuracy for true presence detection and over 97.7% accuracy for realistic long-term ($>$20 hours) test consisting of multiple activities.
- Optimized the control strategy of lighting and HVAC system with distributed sensor network.

Compressive Sensing for Human Localization Using Single Thermopile Pixel Sensor — *College Station, TX, USA*

Research Assistant, Advisor: Dr. Ya Wang — *Aug. 2018 - Mar. 2019*

- Integrated one thermopile sensor and rotating optical mask to acquire compressive infrared signals from human.
- Designed a random binary mask to compress the radiation within the field of view (FOV) [patent pending].
- Built a mathematical model that shows the linear relationship among the output signal of sensor, the rotating mask and radiation distributions. Found the relationship could be solved by compressive sensing theory.
- Reconstructed spatial radiation distributions using basis pursuit denoising algorithm to recover localization information.
- Reached over 90% accuracy for localization of indoor the human object with a very low cost (less than $10).

Co-Mentor of Senior Design Project: Occupant-centered Light and HVAC Control Using Machine Learning for Human Comfort and Energy Efficiency — *College Station, TX, USA*

Research Assistant — *Fall 2019*

- Guided and managed the team to build a lighting and HVAC control system under $100 budget.
- Applied machine learning technology with multiple sensors (temperature, humidity, motion, and light sensors) to analyze the environmental and human factors.

Passive Infrared Sensor for Indoor Localization and Tracking *Stony Brook, NY, USA*

Research Assistant, Advisor: Dr. Ya Wang *Sept. 2017 - Mar. 2018*

- Used a single passive infrared (PIR) and an optical shutter embedded with micro-controller unit (MCU) in the device to analyze occupancy status of indoor environment, such as presence, localization, and facial direction.
- Utilized a innovative rotating optical shutter in front of the PIR sensor to modulation the received infrared radiation in a nonlinear manner.
- Extracted two features from the analog signals from PIR sensors (peak to peak value, and pulse width).
- Applied machine learning algorithms (SVM and Neural Network) to improve the performance in predicting and classifying occupancy situations that reached 98% accuracy in localization.
- Extended the functionality of PIR sensors in indoor occupancy detection with high performance, such as human tracking with 0.44 m RSME, localization with 98% accuracy and facial direction detection with 83% accuracy.

Long-term True Presence Detection Platform *Stony Brook, NY, USA*

Research Assistant, Advisor: Dr. Ya Wang *Jan. 2018 - Jun. 2018*

- Utilized the low-power Lavet stepper motor (< 10mA) to drive a machanical optical shutter on PIR sensors for true presence detection that could detect both stationary and moving occupants [patent pending].
- Built a long-term experiment platform consists of Raspberry Pi, Pi camera, Shutterd PIR sensors and MCU.
- Used computer vision algorithms (YoLo and R-CNN) on videos to extract presence information as groundtruth.
- Reached 97% accuracy for classifying occupied and unoccupied scenes from 31-hour experiment.

VLSI Course Project: VLSI Design for 8-bit Adder *Stony Brook, NY, USA*

Instructor: Dr. Emre Salman *Fall 2016*

- Developed an 8-bit CSA adder with 45nm CMOS technology using Cadence software. The final design showed low power of 1.184 mW, low area of 1257 μm^2, and high speed of 4.34 GHz.

Stony Brook University, Department of ECE *Stony Brook, NY, USA*

Teaching Assistant *Aug. 2015 - Dec. 2017*

- Embedded Microprocessor Systems Design (*Fall 2016*), Digital Systems Design (*Spring 2016*), Digital Signal Processing: Theory (*Fall 2015*)

Publications

Journal Publications

- **Libo Wu**, Fangwang Gou, Shin-Tson Wu and Ya Wang , "SLEEPIR: Synchronized Low-Energy Electronically-Chopped PIR Sensor for True Presence Detection" *submitted to IEEE System Journal*, 2019.
- **Libo Wu**, and Ya Wang , "Compressive Sensing Based Indoor Occupancy Positioning Using A Single Thermopile Point Detector with a Coded Binary Mask", *IEEE Sensor Letter*, 3(12), pp. 1-4, 2019.
- **Libo Wu**, Ya Wang and Haili Liu, "Detection and Localization of Individuals by Monitoring Nonlinear Energy Flow of a Shuttered Passive Infrared Sensor", *IEEE Sensor Journal*, 18(21), pp. 8656-8666, 2018.
- **Libo Wu** and Ya Wang, "A Low Power Electric-Mechanical Driving Approach for True Occupancy Detection Using a Shuttered Passive Infrared Sensor", *IEEE Sensor Journal*, 19(1), pp. 47-57, 2018.

Conference Proceedings

- **Libo Wu** and Ya Wang , "Compressive Sensing Based Indoor Human Positioning Using A Single Thermopile Point Detector", *12th International Workshop on Structural Health Monitoring, September 10-12, 2019, Stanford, California, USA.*
- **Libo Wu** and Ya Wang, "Shuttered Passive Infrared Sensor for Occupancy Detection: Exploring A Low Power Electro-Mechanical Driving Approach", *ASME SMASIS conference*, 2018 (Oral presentation).

Patents

- **Libo Wu** and Ya Wang, "Shuttered Passive Infrared Sensor Apparatus with A Low Power LWIR Liquid Crystal Optical Modulator for Stationary and Moving Occupancy Detection", *U.S. Patent Application No. 62/880,058*, July 29, 2019.
- Ya Wang and **Libo Wu**, "A Single Thermopile Point Sensor Apparatus with A Set of Coding Masks (Compressive Sensing Matrix) for Indoor Human Positioning", *U.S. Patent Application No. 62/863,823*, June 19, 2019.
- Ya Wang and **Libo Wu**, "Shuttered Passive Infrared Sensor Apparatus with A Low Power Lavet Motor Driving Approach for Stationary and Moving Occupancy Detection", *U.S. Patent Application No. 62/863,808*, June 19, 2019.

Honors & Awards

2019 **Graduate Student Travel Award,** J. Mike Walker '66 Department of Mechanical Engineering

2019 **Graduate Excellence Scholarship,** J. Mike Walker '66 Department of Mechanical Engineering

2013 **Bronze Medalist,** Outstanding Undergraduate Scholarship