Senthurbavan Kirubaharan

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Research Interests

My research interest revolves around robotics and AI. I am currently working on mobile robot exploration of unknown areas and have previous research experience in power optimization for ROS-based autonomous mobile robots.

Education

University of Moratuwa (UOM) Moratuwa, Sri Lanka
BSc., Electronic & Telecommunication Engineering with First class Honors *Feb. 2016 – Jan. 2020*
GPA: **3.81/4.2 (3.77/4.0)**

Related Courseworks: Robotics, Robot Design and Competition, Autonomous Systems, Programming Fundamentals, Data Structures and Algorithms, Fundamentals of Computer Organization and Design, Fundamentals of Image Processing and Machine Vision, Neural Network and Fuzzy Logic, Calculus, Linear Algebra, Differential Equations, and Graph Theory.

Research Experience

Intellisense Lab, Computer Science & Engineering, UOM Moratuwa, Sri Lanka
Research Engineer, E-consulate. Working in Intellisense Lab *July 2021 – Present*
Supervised by Dr. Sulochana Sooriyaarachchi & Dr. Chandana Gamage

In Intellisense Lab, I am currently working on the development of mobile robot systems for the exploration of an unknown area.

* Built RTAB-Map SLAM system with a 3D LiDAR and an RGB-D camera
* Developed and tested navigation algorithms in ROS in C++ (based on ROS navigation stack)
* Utilized A* algorithm in BFS frontier exploration to improve next best frontier selection
* Experience with navigation parameter tuning, point cloud processing and ray-tracing for 2D projection, robot hardware, and robot modeling with physical properties for simulation
* Currently migrating the code base from ROS to ROS2

Electronic & Telecommunication Engineering, UOM Moratuwa, Sri Lanka
Undergraduate Researcher, supervised by Dr. Peshala Jayasekara *Feb. 2019 – Jan. 2020*

My research was on the power-optimized navigation of autonomous mobile robots.

* Designed hardware-software co-design for the Trajectory Rollout planner of the ROS navigation stack
* parallelized parts of the trajectory simulation and collision avoidance algorithm and implemented the design in FPGA
* I published (oral presentation) the work as a first author at ACRA 2020

Working Experience

Research Engineer August 2020 – April 2021
SenzMate (Pvt) Ltd *Colombo, Sri Lanka*

During the pandemic, I worked on an AI COVID-19 Wristband that detects the handwashing patterns of the user from the on-board IMU data

* Designed and developed associated firmware and contributed to data collection
* Setup the complete sensing-prediction pipeline for real-time operation
* Trained and tested CNN, RNN, and LSTM models to predict hand movements with real-time constraint

* Implemented high-pass filter to remove gravity from acceleration data to increase prediction accuracy

Research Intern June 2018 – December 2018
SenzMate (Pvt) Ltd *Colombo, Sri Lanka*

I designed the entire communication protocol for multipoint to multipoint reliable communication in LoRa and implemented it as a finite-state machine in the EFM8 microcontroller in C.

Selected Undergraduate Projects

EEG Amplifier for Long-Term Brain Monitoring 2019

- Final year group project supervised by *Dr. Simon Lind Kappel*
- Developed the digital front-end to acquire and process signals from the analog-to-digital converter
- Developed firmware for high-speed signal acquisition, data storage, and Bluetooth communication with a mobile phone for real-time monitoring

Processor Design for Image Downsampling 2018

- Designed a processor for downsampling an image by a factor of two
- Designed instruction set architecture based on RISC-V
- Designed the microarchitecture of the processor and implemented it in FPGA

GPS Navigated Robot 2017

- Participated in a robotic competition, and built a mobile robot with a microcontroller that should navigate through obstacles toward a GPS goal location, identify a box and get the ring placed inside
- Developed obstacle avoidance with 3 ultrasonic range sensors and built navigation component to reach the box

Analog Line Following Robot 2017

- Designed a mobile robot solely with analog electronic circuits to follow a white line on a black surface
- Employed IR emitter and receiver for line detection and designed a PID controller with operational amplifiers for motor speed control

Publications

Senthurbavan Kirubaharan, Peshala Jayasekara & Dilan Weerakkody. Low Power FPGA-based Hardware Accelerator for Autonomous Navigation of Mobile Robots. In 2020 *Australasian Conference on Robotics and Automation (ACRA 2020).* Paper link

Awards

Dean's List (2016, 2019)

Mahapola Higher Education Merit Scholarship (2016)

Skills and Certifications

Languages: English, Tamil

Programming: Python, C/C++, MATLAB, VHDL, LaTeX

Tools and Libraries: ROS, ROS2, NumPy, TensorFlow, Keras, Pandas, Matplotlib, Git

Others: STM32Cube, SolidWorks, Altium, Atmel Studio

Certifications (Coursera): Deep Learning (*DeepLearning.AI*), Machine Learning (*Stanford University*), Aerial Robotics (*University of Pennsylvania*), Computational Motion Planning (*University of Pennsylvania*)