Bharath Sudharsan

Status: Ph.D. student
Fields: Embedded System, Edge Intelligence & Analytics, Enabling AI on Edge MCUs
Activities: Research, Research Implementation & Demonstration, Project grant writing

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Education

Ph.D. CONFIRM Smart Manufacturing, Data Science Institute, NUI Galway — May 2019 - Present

· Design & implement algorithms to improve the Resilience, Interoperability & Scalability (RIS) of tiny IoT devices.

· Design resource-friendly ML model training algorithms for MCUs: My algorithms aim to transform billions of MCU-based IoT edge devices into intelligent devices that can locally build their own knowledge base *on-the-fly* using the live data, thus creating smart self-learning and autonomous problem-solving AI devices.

· Optimization and efficient deployment of CNNs on AIoT boards, small CPUs, and MCUs based tiny IoT devices.

· Collaborative learning/Knowledge sharing by distributed model training: I aim to deploy my highly optimized ML model training algorithm across various IoT devices that deal with sensitive data. After training, without voiding the data privacy, the device learned information is transmitted to a central location, which powers researches and various analytics.

· **Research Publications:** Please visit publications tab at: `https://bharathsudharsan.github.io/profile/`

MEngg in Electronics and Computer Engineering NUIG, Ireland — 2018 - 2019

· Core modules: Computer Security and Forensic Computing, Artificial Intelligence, Mobile Device Technologies, Embedded Image Processing, Electronic Sports Performance and Technology.

· Project, Poster & Publication: Smart speaker design and implementation with biometric authentication and advanced voice interaction capability. 27^{th} AIAI Irish Conference on Artificial Intelligence and Cognitive Science.

· Project, Poster & Publication: AI Vision: Smart speaker design and implementation with object detection custom skill and advanced voice interaction capability. 11^{th} International Conference on Advanced Computing.

· Project & Publication: Unsupervised method to analyze playing styles of EPL teams using ball possession-position data. 7^{th} International Conference on Advanced Computing & Communication Systems.

· Project & Publication: A microphone array and voice algorithm based smart hearing aid. International Journal of Computer Applications.

Work Experience

R&D - Embedded System Engineer - Four Corners Technologies Pvt. Ltd, India — Oct 2016 - Nov 2018

· Workspace Occupancy Monitoring: We designed a wireless embedded system with Panasonic Grid Eye thermal sensor to monitor the workspace occupancy. This occupancy data was sent to our web app to generate client requirement-based meaningful insights such as; Rich visualization & reporting of building & workspace utilization, detailed occupancy patterns, extensive reporting of occupancy by department & by function, etc.

· Remote Hoardings Monitoring: We designed an IP66 grade Linux-based IoT camera with 4G connectivity and integrated multiple outdoor LDR sensors. 250 of our IoT cameras were installed across the state to monitor the outdoor billboards to provide view clarity, material & installation quality, pillar quality, lighting quality, live stream, etc when requested by the billboard owners or clients via our billboard management system.

· Retail Sense, 'Progressive business decisions with live data at your fingertips'. We designed Retail Sense, which is a low-cost camera-based wireless footfall people counter. The raw footfall count was sent to our web app, where it was converted into meaningful information that revealed patterns and profitable insight which was used to make key decisions on; ideal staffing levels and placement based on the hour, day, month & season, facility's layout and operations, etc.

· e-Health Kiosks: We designed an MCU based embedded system with Height (MaxBotix Ultrasonic), Weight (load cells mapped to a 24 bit ADC) & Heart rate (Max30100 Pulse Oximetry) sensors interfaced with it. This board computes the height (cms) weight (Kgs) and heart rate (BPM & SPO2) and sends it to the system of the Digital Signage kiosk via USB.

IoT R&D Intern - Flamenco Tech India Pvt. Ltd. — Jul – Aug 2016

· Sensor Integration for Smart Parking System, Client POC: Installed and integrated hundreds of ceiling, parked car detection ultrasonic sensors into Client's Smart Parking System.

Skills

Embedded hardware design for IoT applications

· Multi-sensor, wireless, Low-power Embedded system design with various ARM MCUs. Embedded architecture-aware SW development using PICCCS, Keil, or other Embedded development Tools, IDEs & Debuggers (JTAG).

· Wireless & wired communication systems, protocols & peripherals such as BLE, Wi-Fi, LTE, GPS/GNSS, CoAP, MQTT, 6LoWPAN, Z-Wave, ZigBee, LoRaWAN, SigFox, AMQP, XMPP, HTTP/2.0. Digital, Analog, I2S, USB, UART, CAN, I2C, SPI, RS232 & RS485.

· Hands on embedded system design experience using Panasonic's PaPIRs, Grid-EYE infrared arrays, MaxBotix's range finders, Maxim Integrated's healthcare sensors, range of Thermoelectric Peltier Modules, Interlink's FSRs & Flex sensors, Melexis'c contactless IR temp sensor, ST's FlightSense ToF technology, ReSpeaker mic-arrays, and others.

· Schematic Capture, PCB Layout, Fab package release (Gerber, Drill, BOM, etc.) to build mixed-signal hardware using Proteus or Eagle.

· Experienced using Digi's wireless SOCs & networks, Intel Movidius NCS, Nvidia Jetson Nano, Leap motion, other SBCs & MCUs like Raspberry Pis, Intel NUC series, Google Coral, LattePanda boards, STM32 blue pills, Espressif modules, Nordic SoC's, Arduino boards, etc.

C, Embedded C, C++, Micro Python & Python for IoT apps at Edge, Fog & Cloud

· Design, build & maintain efficient & reliable code.

· Familiar with Unix environment, Shell scripting and Git-based source control system.

· Programming for Multi-thread, RTOS and Power constrained wireless (typologies-based) environments.

· Experience setting up hosting environments, integrating IoT edge with Azure, ThingsSpeak, Dweet, IBM Watson, Node-Red, Digital Ocean & AWS with its database, analytics, visualization, and other services.

· Firm experience in selecting and programming a wide range 8, 16 & 32-bit MCUs, Microprocessors & FPGA depending on the IoT use-case, hardware budget & design specification.

AI/Machine Learning for IoT Edge Analytics

· Tensorflow Lite & Micro framework with Python's libraries such as Numpy, SciPy, Matplotlib & Pandas.

· Exposure to image recognition, object detection & tracking using Open CV or Deep Learning.

· Knowledge to optimize model size, workload & operations, perform quantization-aware training and post-training quantizations. Stitching models with IoT application code, building executable binaries and deploying on MCUs.

· Firm knowledge in developing advanced edge analytics, signal processing, and computer vision algorithms, Implementation of DNNs & other complex models based on state-of-art architectures

· Design of use-case based anomaly detection, forecasting & classification model, followed by its HW, SW co-optimisation & compression to deploy on resource-constrained IoT Edge.

Additional skills

· Handling multiple development aspects from edge to cloud, support quality & manufacturing groups, technical documentation, clear verbal & written communication, creating release notes, releasing & archiving projects, using change management systems (JIRA). Basics of Docker, Matlab & LabVIEW.

· Ensuring design complies with Industrial/relevant standards, ensure all health, safety, environmental & regulatory requirements are met. Knowledge of PCB manufacturing processes, assembly & equipment.

Grants

Assess, Respond, Monitor, Strengthen Glove (ARMS glove) for stroke - Blackstone Launchpad - NUIG — Nov 2018 - Feb 2019

· Project, Poster & Bench demo: Post hand paralysis or injury, patients often require lengthy, repeated and therapists supervised clinical training to regain muscular control and function. Our wearable facilitates patients to perform various supervised interventions at their convenient place and time without the presence of therapists.

Microphone Array and Speech algorithm-based Smart Hearing Aid with Liveliness detection - Blackstone Launchpad - NUIG — Nov 2019 - Present

· To design, implement & integrate a light-weight sub-system with existing digital voice assistance across a broad range of voice-controlled devices to intelligently differentiate live voices from voices coming out of devices.

Milestones

Smart Portable IoT Vaccine Monitor - Mouser IoT Design Contest Dec 2015 - Jul 2016

· Second place, National level, India: When the environment is not optimal the efficacy of vaccines is lost, especially when health workers carry vaccines in a portable box during door to door polio vaccine campaigns. Our device continuously monitors the proximity of vaccines using multiple sensors, runs local analytics to ensure the efficacy is preserved. Our device raises timely alerts which prevent administering less potent vaccines during campaigns.

Gesture Control Glove - Atmel India University Program Embedded design contest Oct 2015 - Apr 2016

· Finalist, National level: During seminars & presentations, to provide a seamless user-machine interaction, we designed & implemented a sensor & BLE based wearable which helps the presenter to achieve greater synchronization while performing control tasks such as window switching, document scrolling, slide navigation, audio-video controls, etc.

Secure Baggage using PSc - OpenGovDataHack Oct 2017 - Nov 2018

· PSc is a BLE & sensor-based Embedded System which we designed and programmed to act as a virtual locker for securing belongings of passengers using public transports. Runner up of NIC-IAMAI #OpenGovDataHack conducted across 7 cities nationwide, qualified for final presentation before Shri Ravi Shankar Prasad, Minister of Electronics & Information Technology, Govt of India. Nominated for Tata Consultancy Services (TCS) best project award and also participated in Smart India Hackathon by The Ministry of Civil Aviation, India.

Professional Development Courses

Open Source and the 5G Transition - LinuxFoundationX via edX Nov 2019

· Open 5G network, Standards & software, Integrating 5G into business strategy, Considerations & going forward

Applied AI with DeepLearning - IBM via Coursera Jul - Aug 2019

· DeepLearning Frameworks (Keras, TensorFlow, SystemML & DeepLearning4J), DeepLearning Applications (Anomaly Detector, Time Series Forecasting, Image classification & Sequence Classification), Scaling and Deployment (IBM Watson Visual Recognition, Tasks in ApacheSpark using DL4J & SystemML)

MediaTek Smartphone Design Training Program - India & Taiwan Feb - Apr 2018

· Mobile design process, Performance testing & tuning, Basic BSP knowledge, Taiwan mobile phone eco-system tours, Real practice in MediaTek, Digital /Analogue /Cellular RF /Wireless Connectivity /Multimedia relative knowledge, Camera/Audio tuning, Power consumption & thermal design, Certification & regulation, Case study (measurement and debugging), Mobile market segmentation & positioning

Architecting Smart IoT Devices - EIT Digital via Coursera Apr - Jun 2018

· Hardware & Software for EmS (MCU, SOC, FPGA, Cache, pipeline & coupling, Sensor Networks, Protocol stacks, Licenses, SensorTag Experiment), RTOS (Real-time Scheduling, Synchronisation and Communication, Device Drivers), System Finalisation (Code Tuning, Security, Realtime & Logical remote debugging, Simulation on host)

Cybersecurity & the Internet of Things - University System of Georgia via Coursera Jan 2019

· Organizational Risks in industrial Sector, Application in Smart Grid, Security & Privacy Issues, Interoperability & Security issues, Connected Home & Community, Consumer Wearables (Wearable Computing, Objective Metrics, Quantified Self)

Introduction to Linux - LinuxFoundationX via edX Feb - Apr 2016

· Linux Philosophy & Community, Partitions, Filesystems, Boot process, Environment Variables, Permissions, Security, Commandline, Encryption, Bash Shell Scripting & Debugging

Fundamentals of Digital Image and Video Processing - Northwestern University via Coursera Oct - Dec 2016

· Signals & System, Fourier Transforms & Sampling, Motion Estimation, Image Enhancement, Image Recovery, Lossless Compression, Video Compression, Image & video segmentation, Sparsity