

ELE 464: Embedded Computing – Project Details

Spring Semester

Project requirements:

- A one-page writeup on what you intend to do for the project due on Feb. 24.
- Midterm progress report (typically four double-column single-spaced pages) due on Mar. 24: 10 points. Sections to be included: Abstract; Introduction; Background; Motivation; Top-level flowchart and description of the proposed approach; Comprehensive set of references.
- Final progress report (typically eight double-column single-spaced pages) due on May 3: 20 points. Other sections to be added: Detailed description of the proposed approach; Experimental results; Discussions and limitations; Conclusions and future work.
- Write-ups due in class (the final report due in my office).

Project ideas

From Sensor to Edge to Cloud

- Sensor nodes: inference and security on the sensor node; intermittent computing; energy harvesting.
- Edge computing: small-data analytics; statistical signal processing; federated learning; energy-efficient architectures (reconfigurable, monolithic 3D, non-volatile memories, hardware-software co-design, in-memory computing).
- Cloud computing: preparing data for big-data analytics; algorithms/architectures for big-data analytics; data mining; unsupervised learning; neural nets (architecture, training time); graph models; cloud architectures (energy-efficient, non-volatile memories, resilient, networked, accelerators, modeling).
- Hierarchical IoT analytics at the sensor-edge and edge-cloud levels.
- Detection and mitigation of security vulnerabilities in IoT and cyber-physical systems, e.g., Internet-of-Medical-Things, Internet-of-Aviation, autonomous vehicles, etc.
- Use of motion sensors (accelerometers, gyroscopes, etc.) to find PINs/passwords on smartphones using neural networks.
- Use of motion sensors to detect what is typed into browsers.
- Key fob analysis: amplification/replay attacks
- Analyzing the impact of inaudible commands to voice assistants.

Smart Healthcare

- Use of wearable medical sensors (WMSs) for medical diagnosis.
- Use of WMSs for obtaining a 24-7 emotional profile.
- Use of WMSs to track quality of learning.
- Use of WMSs and smartphones to convey our emotions to each other in real-time.
- Use of WMSs for deception analysis.
- Use of WMSs to obtain blood glucose levels through regression.
- Healthcare privacy based on synthetic data generation.
- Use of WMSs for sports performance analysis.
- Use of WMSs for monitoring the health condition of patients at home.
- Medical decision-making: analyzing which interventions are good for a patient through counterfactual analysis.

Smart Homes/Buildings

- Use of on-body temperature/humidity sensors for thermal comfort analysis: the aim is to keep everyone in the home/building thermally comfortable at all times.
- Use of sensors to track occupant locations to enable rotatable radiant heaters to cut heating energy by half.
- Safety vs. security analysis of smart homes/buildings.
- Analysis of information leakage through eavesdropping on wireless communication from sensors to home/building controllers.

Smart City

- Sensors for monitoring the structural health of infrastructure: bridges, roads, etc.
- Traffic congestion analysis using motion/image sensors.
- Urban noise maps through acoustic sensors.
- Evaluating the cost savings due to LED street lighting.
- Using analytics to make roads/highways smarter: suggesting alternative routes in real-time, evaluating safety, etc.
- Smart metering: analysis of energy consumption; impact of photovoltaics; scheduling the running of appliances based on real-time electricity pricing.
- Smart grid: sensors, electronics, signal processing, security.
- Smart parking.

Your Favorite Topic in Embedded Computing