SensiML Add Predictive Maintenance in Smart Building Devices Instructions

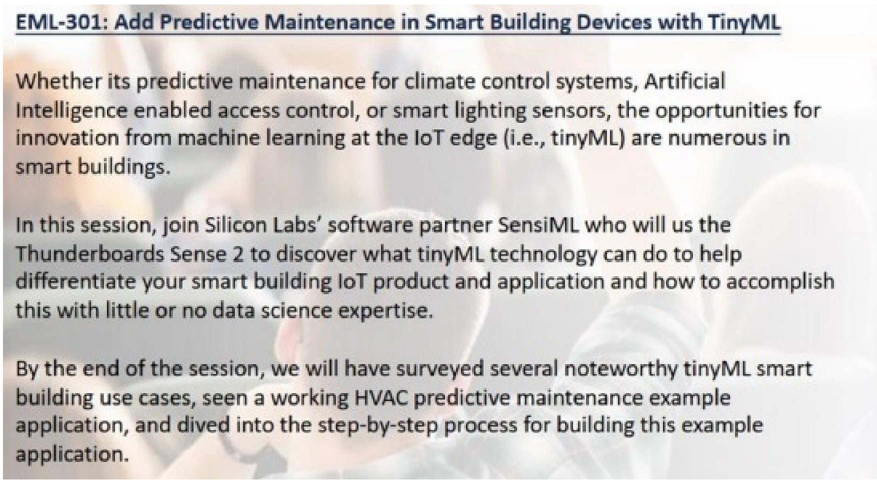
Contents

SensiML Add Predictive Maintenance in Smart Building Devices

Agenda

Pre-work: Users to have installed Simplicity Studio and SensiML Analytics Toolkit in advance

- **Host Introduction –** 5 minutes
- **Introduce concepts and goal for lab –** 10 minutes
- **"Real-time" execution of step-by-step procedure for model creation –** 60 minutes
  - Flash SensiML compatible data collection firmware to the Thunderboard Sense 2 (TBS2)
  - Configure and connect TBS2 to SensiML Data Capture Lab
  - Capture 'slide demo' data with bare board (users won't have Fan kits)
  - Label data and save and sample project (we won't be using for the remainder of the course though)
  - Invoke Analytics Studio (at this point, users will be working from pre-collected TBS2 fan demo dataset)
  - Work through the steps for model building the fan state detection model
  - Create a Knowledge Pack
  - Optional: Flash model to TBS2
- **Smart Building Applications demo video –** 5 minutes
- **Q&A –** 10 minutes



EML-301: Add Predictive Maintenance in Smart Building Devices with TinyML

Whether its predictive maintenance for climate control systems, Artificial Intelligence enabled access control, or smart lighting sensors, the opportunities for innovation from machine learning at the IoT edge (i.e., tinyML) are numerous in smart buildings.

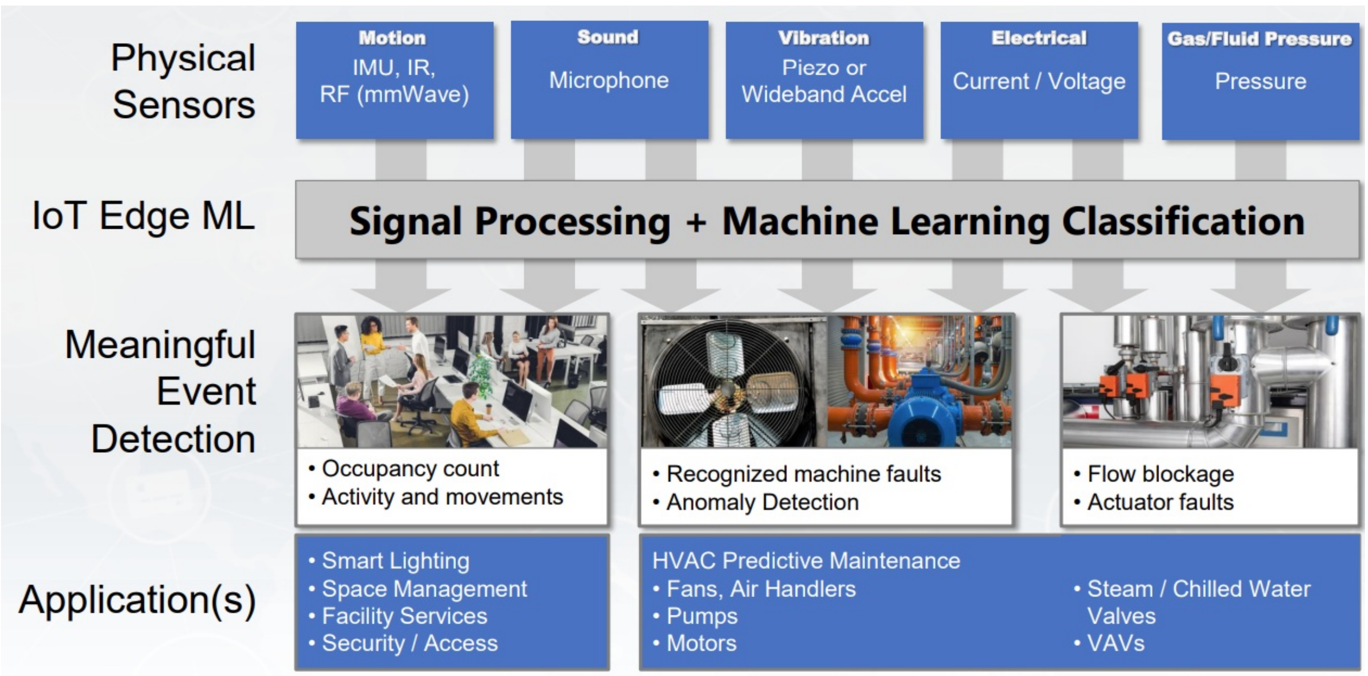
In this session, join Silicon Labs' software partner SensiML who will us the Thunderboards Sense 2 to discover what tinyML technology can do to help differentiate your smart building IoT product and application and how to accomplish this with little or no data science expertise.

By the end of the session, we will have surveyed several noteworthy tinyML smart building use cases, seen a working HVAC predictive maintenance example application, and dived into the step-by-step process for building this example application.

SensiML Introduction

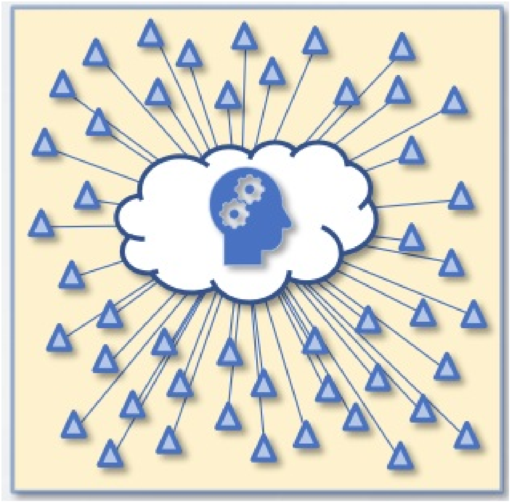
- SensiML is a B2B software tools company for AI at the IoT edge
  - Enables developers to create ultra-compact ML sensor models without data science expertise
  - Models as small as 10KB!
  - Former Intel Curie/Quark MCU AI software tools team, left to form SensiML in 2017
- Silicon Labs and SensiML Solution
  - Bringing power efficient ML to the EFR32/EFM32 MCU family
  - Rapid smart IoT application prototyping with Thunderboard Sense 2
- SensiML has stability and worldwide support
  - Acquired in 2019 by QuickLogic Corp; setup and run as wholly independent software subsidiary (based in Portland, OR)
  - Established channel partners (Avnet, Future Electronics, Mouser, Shinko Shoji)
  - Sales/Support offices in UK, US, Japan, Taiwan, China

Opportunities For TinyML in Smart Buildings



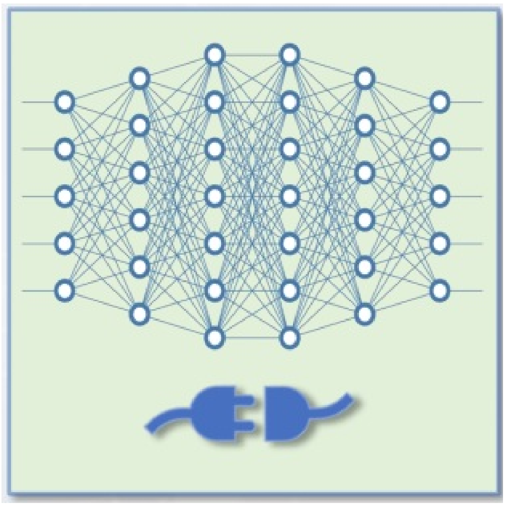
Challenges with Existing Smart IoT Sensor Application Development

Cloud-Centric AI



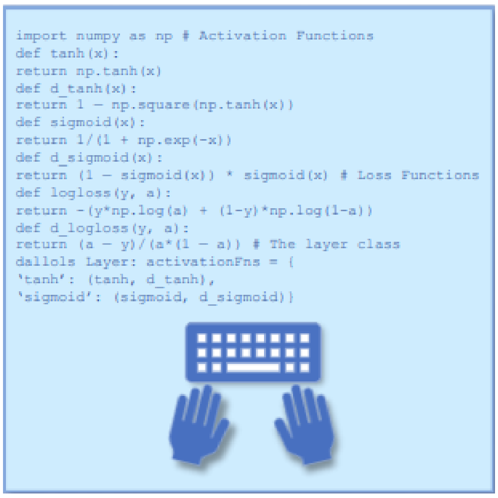
- High Network Traffic Load
- High Latency
- Less Fault Tolerant
- Unknown Risk of Data Security
- Concerns of Privacy

Deep Learning



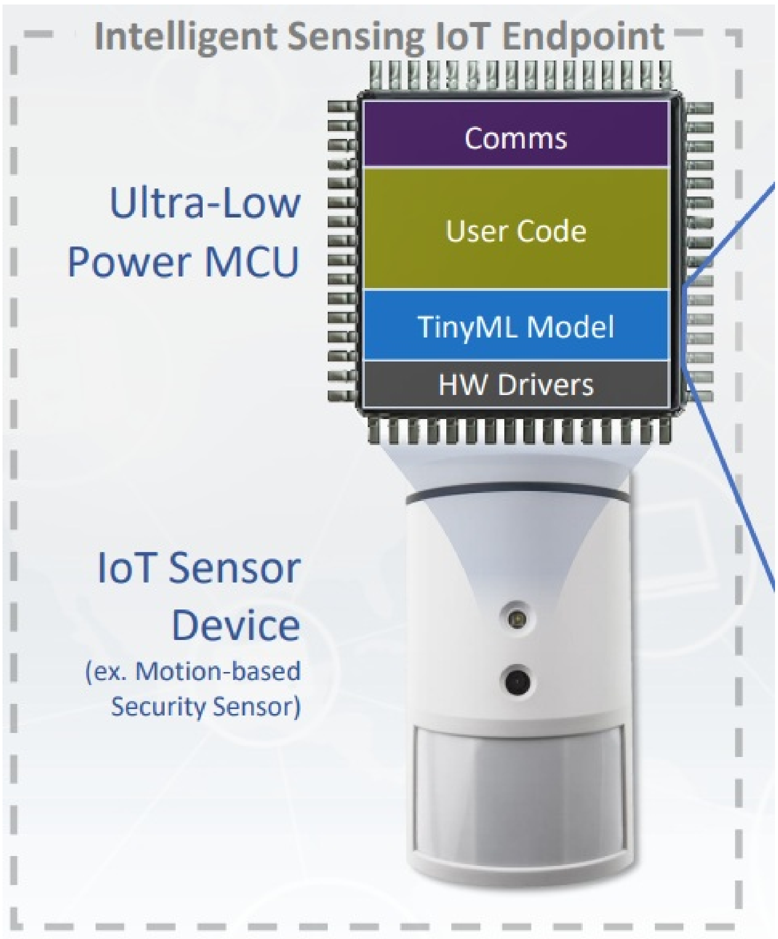
- Large training data requirements
- Large memory footprint
- High processing workload
- High power consumption
- Poor endpoint battery life

Hand-Coded Endpoints



- Slow and labor-intensive
- Unknown code size upfront
- Scarce data science expertise
- Complex AI/ML code libraries
- Not scalable/competitive

TinyML = IoT Edge ML + AutoML



- **IoT Edge ML:** Autonomous endpoints
  - Trivial network throughput and long wireless battery life
  - No cloud processing or network dependencies
  - Real-time responsiveness

- **AutoML:** Optimize Without AI Expertise
  - Auto-optimizer selects best model for the data provided
  - Classic machine learning (ML) up through deep learning
  - SensiML TinyML yields models as small as 10KB!
- **Hand-coding not required**
  - Model code auto-generated from ML training datasets
  - Saves months of development effort, and data science expertise
  - Developer can change any aspect of the AutoML code as desired

Model Building Workflow

Capture Data

SensiML Data Capture Lab

- **Time:** Hours to Weeks* (Depending on application data collection complexity)
- **Skill:** Domain Expertise (As required to collect and label events of interest)

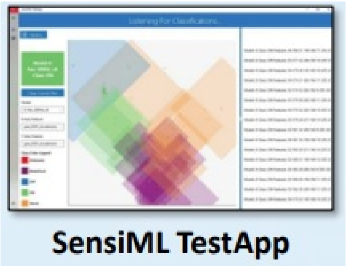
Note: We'll be leveraging some previously collected data to accelerate this step for the workshop

Build Model

SensiML Analytics Studio

- **Time:** Minutes to Hours (Depending on degree of model control exerted)
- **Skill:** None (Full AutoML)
  - Basic ML Concepts (Advanced UI tuning)
  - Python Programming (Full pipeline control)

Test Device

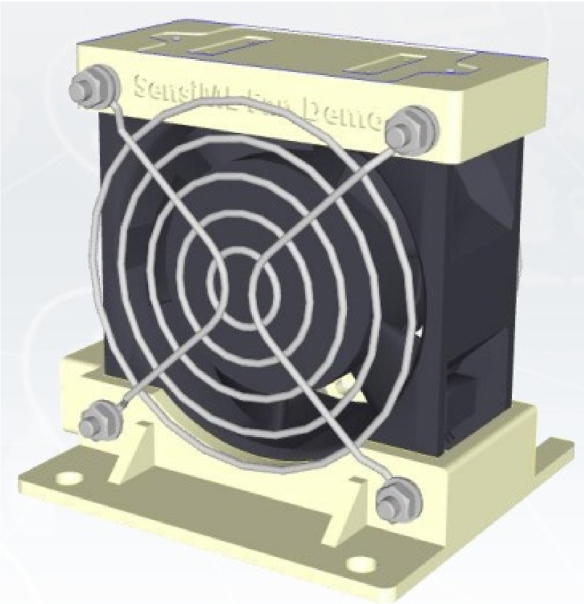


- **Time:** Minutes to Weeks (Depending on app code integration needs)
- **Skill:** None (Binary firmware with auto generated I/O wrapper code)
  Embedding Programming (Integration of SensiML library or C source with user code)

Workshop Goals

- Introduce SensiML's TinyML toolkit and the model building process on Silicon Labs Thunderboard Sense 2
- Experience with data-driven supervised ML sensor algorithm development
- Learn the workflow from data collection through validation and on-device testing for building IoT models
- Build a working HVAC predictive maintenance model start-to-finish
- Address questions you may have about the TinyML model creation process

A Working HVAC Predictive Maintenance Application



- For purposes of our hands-on portion, we're going to be building a smart fan-monitoring device
- Fans used ubiquitously in building HVAC systems: Blowers, active cooling of equipment, air handlers, ventilation ducting
- Failure or degradation can cause loss of efficiency, increased energy consumption, HVAC failures
- We'll construct a simple monitoring device that can detect multiple normal and abnormal fan states:
  - Fan off / on
  - Loose mounts
  - Fan guard obstruction
  - Partial or fully blocked airflow

- Blade impingement
- Excess vibration

Let’s Begin the Process

“Real-time” workshop step-by-step procedure for model creation – 60 minutes

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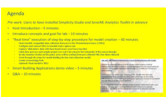
- Flash model to TBS2

Demo Video

Documents / Resources

	[SensiML Add Predictive Maintenance in Smart Building Devices] [pdf] Instructions Add Predictive Maintenance in Smart Building Devices, Maintenance in Smart Building Devices , Smart Building Devices, Building Devices

References

- SensiML Smart Building IoT Sensing Solutions with Silicon Labs