MATLAB Embedded Coder for Intel Curie Platform

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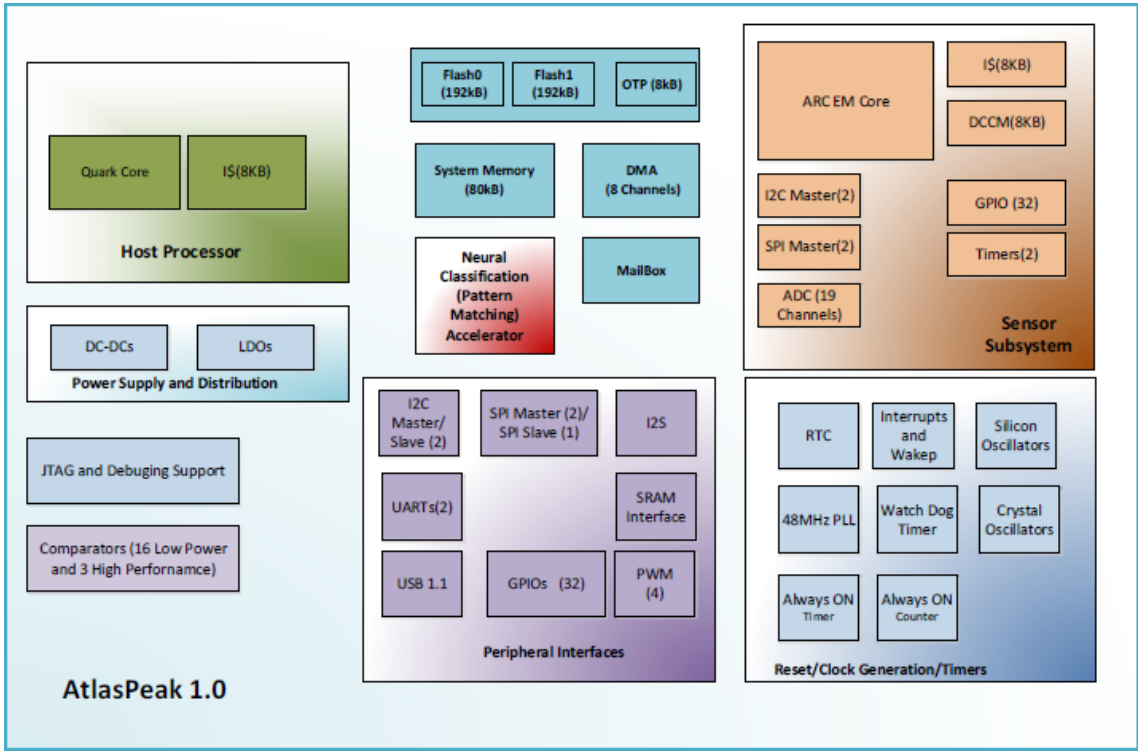
Agenda

- Intel Atlas Peak Wearable SoC Platform Overview
- Curie Module and Arduino 101
- MATLAB Embedded Coder for Curie Platform
- Case Study – Biking Trick Classifier
- Summary

Atlas Peak SoC Platform Overview



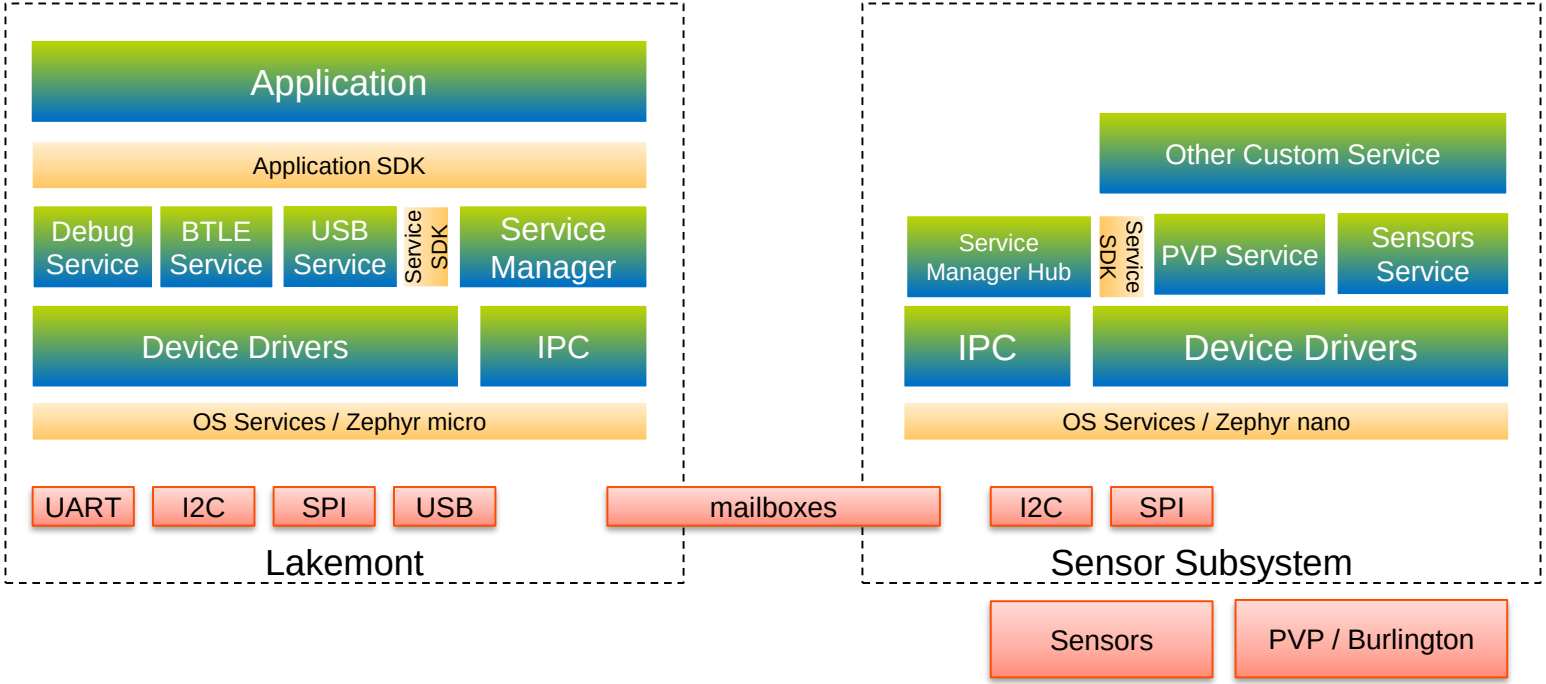
Quark Core (LMT)
- 32 MHz Clock Frequency
- 32-bit Address Bus
- 8 kB L1 Instruction Cache

ARC EM Core - Sensor Subsystem
- 32 MHz Clock Frequency
- I2C Master, SPI Master, ADC, GPIO, timers
- 8 kB L1 Instruction Cache

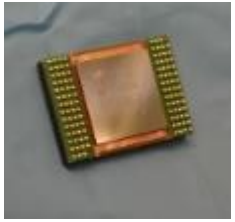
PVP – Pattern Matching Accelerator
- Parallel data recognition engine
- 128 Neurons with 128 features per Neuron

On-Die Memory
- 384 kB of on-die Flash
- 80 kB of on-die SRAM

Atlas Peak SW Architecture

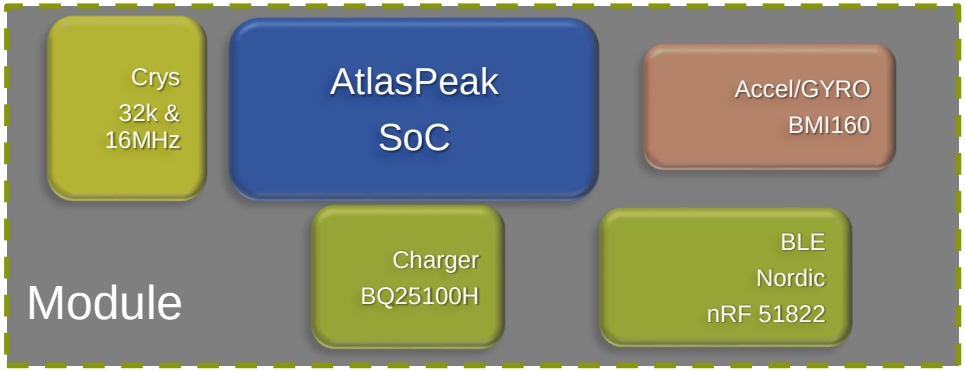


Curie Module and Arduino 101



Physical	
Form Factor	BGA module
Dimensions	8x10x2mm (TBD)
SoC	AltasPeak 1.0, 32MHz
Storage	NA
Memory	within SoC, 80KB RAM
Sensors	Accel/Gyro,

Key EE components	
SoC	AtlasPeak1.0
Sensor	6 Axis BMI160
Charging	BQ25101
BLE	Nordic nRF51822



Arduino 101

https://www.arduino.cc/en/Main/ArduinoBoard101

Open Source FW Code:

https://github.com/CurieBSP

PVP Pattern Matching Acceleration

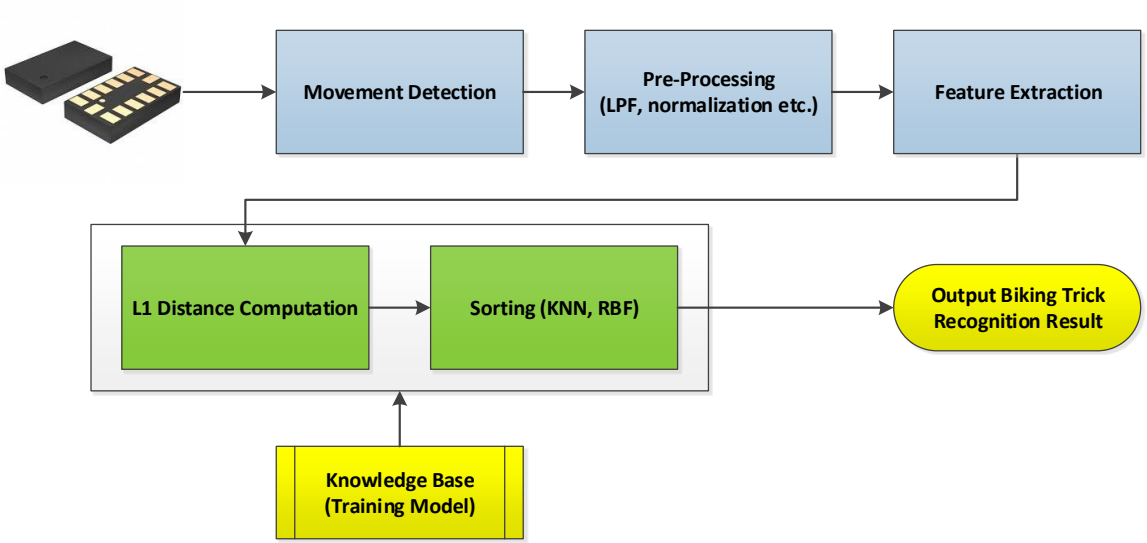
- Highly parallel 128-vector distance computation and sorting
- 16KB of closely coupled memory attached to the neurons for high throughput
- Input – vector to be recognized
- Output – fired neurons or the nearest neighbors
- Computationally intensive modules
  - Distance computation between the input vector and reference vector
  - Sorting to find the nearest neighbor, especially for kNN & RBF

MATLAB Embedded Coder for Curie Platform

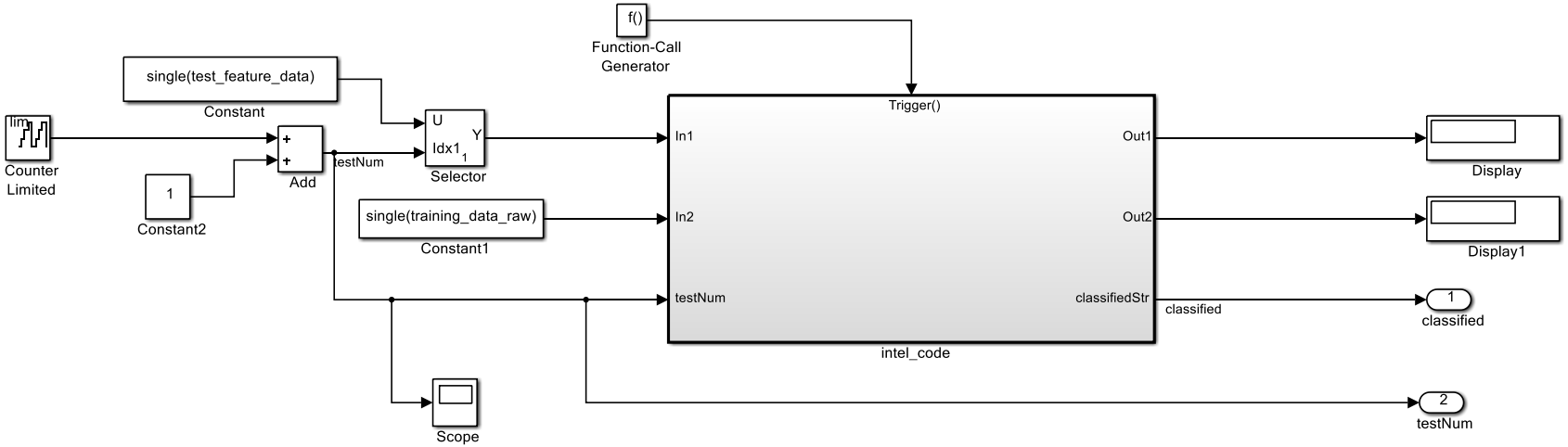
- Optimization and code configuration options from Mathworks
- Multi-task and multicore code execution
- Best utilize features on Curie platform for quick prototyping
  - x86 Quark CPU
  - ARC DSP with FPU and DSP extension
  - PVP pattern matching HW accelerator
  - Optimized math library for ARC

Case Study – Biking Trick Classifier

- Biking trick: type = {'UnKnown'; 'Big Air'; 'Tobogan'; 'BackFlip'; 'XUp'; 'TailWhip'};



Biking Trick Classifier – Simulink



Biking Trick Classifier – Quark/ARC

Contents

Summary

Subsystem Report

Code Interface Report

Traceability Report

Static Code Metrics Report

Code Replacements Report

Generated Code

[−] **Main file**

ert_main.c

[−] **Model files**

demo_model.c

demo_model.h

demo_model_private.h

demo_model_types.h

[−] **Data files**

demo_model_data.c

[+] **Utility files (1)**

```
 * Embedded hardware selection: Intel->x86-32 (Windows32)
 * Code generation objectives: Unspecified
 * Validation result: Not run
 */

#include "demo_model.h"

static boolean_T OverrunFlag = 0;

/* Base rate step function */
void rt_OneStep()
{
  /* Check for overun */
  if (OverrunFlag++) {
    rtmSetErrorStatus(demo_model_M, "Overrun");
    return;
  }

  /* Step the model for base rate */
  demo_model_step();

  /* Get model outputs here */
  OverrunFlag--;

  /* Disable interrupts here */
  /* Restore FPU context here (if necessary) */
  /* Enable interrupts here */
}

/* Genesis target Main function */
void mw_arc_initialize(void)
{
  /* Initialize model */
  demo_model_initialize();
}

/* Genesis target Main function */
void mw_arc_terminate(void)
{
  /* Terminate model */
  demo_model_terminate();
}
```

Biking Trick Classifier - PVP

DRIVER_API_RC qrk_cxxxx_pvp_recognize_vector(…)

DRIVER_API_RC qrk_cxxxx_pvp_save_knowledge(…)

DRIVER_API_RC qrk_cxxxx_pvp_load_knowledge(…)

DRIVER_API_RC qrk_cxxxx_pvp_set_config(…)

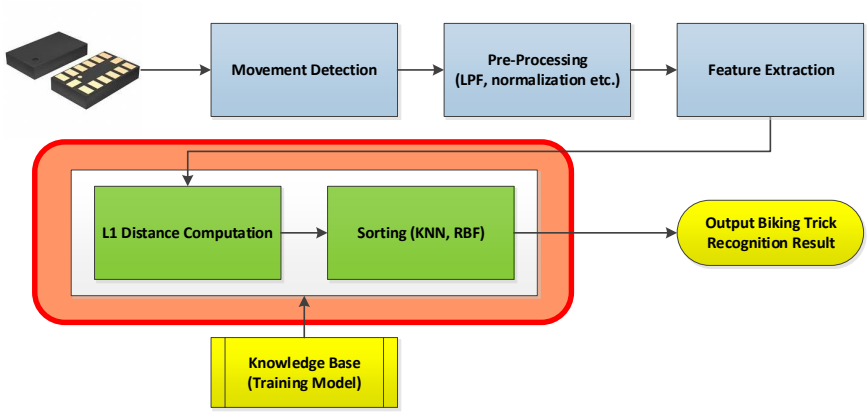
DRIVER_API_RC qrk_cxxxx_pvp_get_config(…)

DRIVER_API_RC qrk_cxxxx_pvp_reset_database(…)

DRIVER_API_RC qrk_cxxxx_pvp_read_neuron(…)

DRIVER_API_RC qrk_cxxxx_pvp_clock_enable(…)

DRIVER_API_RC qrk_cxxxx_pvp_clock_disable(…)



Demo Session

- Run Biking Trick Classifier purely in MATLAB Simulink.
- Embedded Coder generates the ARC optimized C code, and then uses Curie platform toolchain to compile and generate the library.
- Library is further built with CurieBSP firmware codebase and becomes part of firmware image.
- Flash the newly generated image to Arduino 101, and the same result is shown.

Summary

- Intel Atlas Peak SoC brings extremely low power and rich feature set for wearable and IOT segments.
- MATLAB Embedded Coder supporting for Atlas Peak platform enables broader eco-system adoption for quick prototyping, code and algorithm optimization.