

The urdf1ib Library for MicroPython: Manipulating RDF on Constrained Devices

Problem

Semantic Web of Things application development requires **specialized C/C++ developer skills** and to account for **processing and memory constraints** of IoT devices.

MicroPython is easier to learn and use than C but it has **no RDF library**.

- ▶ How to **ease the development of RDF manipulation in MicroPython?**
- ▶ How to **adapt to typical constraints of IoT systems?**

Proposal: urdf1ib

- ▶ **Library for RDF processing, based on MicroPython**
- ▶ **API conforms to the RDFLib Python library**
- ▶ **Simple, accessible, lightweight**



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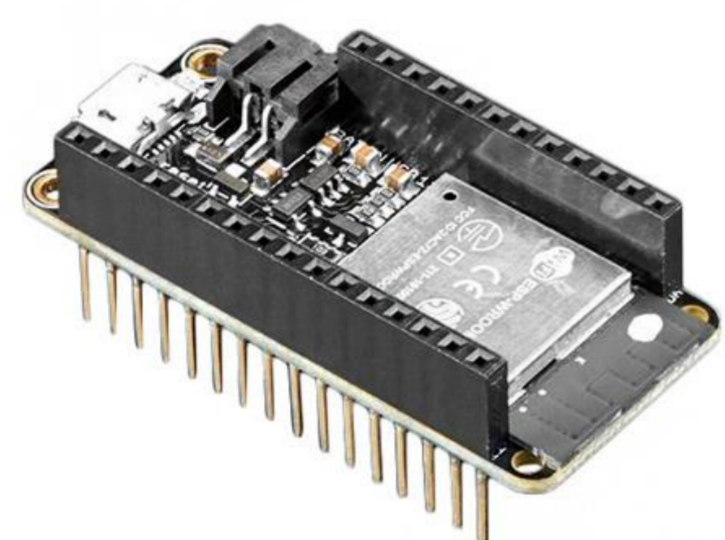


MicroPython



- ▶ Full Python compiler and runtime runs on top of existing micro OS
- ▶ MicroPython ports for: Arduino, ESP32, unix, windows, Zephyr, Webassembly, nRF chips, samd, stm32, rp2, pic16bit, ... and many variants

ESP32



- ▶ 240 MHz dual core
- ▶ 520 KB SRAM, 4MB Flash
- ▶ Wi-Fi, BLE, UART, I2C, SPI, ...

Performance evaluation

- ▶ adds 27 KB to the 1.5 MB ESP32 firmware (+1.5 %)
- ▶ RDFLib vs urdf1ib on unix port vs urdf1ib on ESP32

Performance Evaluation

Platform	# triples	Initial Time (us)	Adding Time (us)	Memory Allocation (B)
py-rdf1ib	100	173302	6544	289640
py-rdf1ib	1000	180661	65505	2319151
py-rdf1ib	10000	180499	449035	22944084
mpy-unix-urdf1ib	100	17	1222	60160
mpy-unix-urdf1ib	1000	20	15857	578560
mpy-unix-urdf1ib	10000	32	115643	1909248
mpy-esp32-urdf1ib	50	12276	90363	18880
mpy-esp32-urdf1ib	100	10924	179512	34880
mpy-esp32-urdf1ib	180	8001	330541	60480

urdf1ib module for MicroPython

- ▶ **Re-implements a subset of the RDFLib API**
 - With C backend: Sord/Serd/Zix
 - API decoupled with the C backed library
 - namespaces, parsers and serializers, SPARQL plugin
- ▶ **Integrated in the MicroPython firmware**
 - As additional user module
 - `import urdf1ib as rdf1ib`
- ▶ **FAIR resource**
 - Permanent DOI on Zenodo,
 - Open source and open license on GitHub
 - Documentation, instructions to build and test
 - Improved documentation to develop MicroPython module

Future work

- ▶ **Looking for test cases and contributors!**
- ▶ Support greater subset of RDFLib
- ▶ Use compact data structures for storing IRIs
- ▶ Use native datatypes for storing literals
- ▶ Serializers and parsers for compact syntaxes
- ▶ API for SPARQL, lightweight reasoner LiRoT, ...

Project



Constrained Semantic
Web of Things,
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<https://coswot.gitlab.io/>