

# Overview of Real-time Operating Systems for embedded devices

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# *Introduction*

Real-time operating systems can be used for embedded devices management, smart home automation, for civil or military aviation – for optical devices and weapon controls management. Real-time operating system manages devices with that has:

- limited resources
- limited time to complete task
- sensors for communication

Target of the paper is to explore and describe features of well-known RTOS such as: FreeRTOS, Zephyr and Armbian GNU/Linux. Paper performs the Overview task of PhD thesis.

# Materials and Methods

Programming languages for real-time os development are C or Assembly language. Usage of assembly language gives more control of current task execution. For every RTOS will be analyzed:

- Short description
- Supported virtualizators
- Supported Instruction set architectures
- Embedded device which is supported by the os

# FreeRTOS

Short Description	Supported Virtualizators	Supported ISA	Supported microcontroller modules
Written in C, modular libraries, supports AWS	QEMU, Virtualbox	X86, ARM-RISC, PIC	PIC24-RISC based, SIFive board-RISCV based

FreeRTOS Docs (2023).

# Zephyr OS

Short Description	Supported Virtualizators	Supported ISA	Supported microcontroller modules
Written in C, multi-thread OS	QEMU	ARM64,x86	NEORV32-RISCV based Adafruit KB2040-RISC based

**Zephyr Docs** (2023).

# Armbian

Short Description	Supported Virtualizators	Supported ISA	Supported microcontroller modules
Debian – ported OS for microcontroller modules; SD card can be used for storage	QEMU	X86_64, RISC	OrangePi, BananaPi

**Armbian Docs** (2023).

# Best RTOS 2023



## FreeRTOS

FreeRTOS

[See Software](#)

FreeRTOS, which was developed in partnership with some of the world's most renowned chip companies over a 15 year period, is now downloaded every 170 second. It is a market-leading real time operating system (RTOS), for microcontrollers, small microprocessors. FreeRTOS is freely distributed under the MIT open-source license. It includes a kernel as well as a...



## Mbed OS

Arm

[See Software](#)

Arm Mbed OS, an open-source IoT operating platform, is free and available for download. It includes all the features needed to create IoT products. The OS contains everything you need for smart, connected products that run on Arm Cortex M based hardware. This includes machine learning capabilities, security stacks, connectivity stacks, and drivers for sensors and other...

# Results

- FreeRTOS, Zephyr and Armbian OS are analyzed and compared.
- Virtualizators for x86 simulation are shown.
- For every OS is shown supported device



# Conclusions and future work

Analyzed operating systems are written in C and they support RISC-V architecture because of C. But when requirements for the RTOS are OS to be much faster and more useful for RISC-V projects then exists need to develop truly RISC-V assembly-based OS. That is main target of my PhD thesis.

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PhD thesis theme -> Methods and Tools to develop a assembly-based operating system for embedded devices

# References

1. **A practical introduction to real-time systems for undergraduate engineering**
2. **FreeRTOS Documentation, 2023**
3. **Zephyr Documentation, 2023**
4. **Armbian Documentation, 2023**