**Free Assembly Languages for developing real-time operating system for embedded devices**

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**Abstract:**

**Keywords: risc-v assembly, avr assembly, operating system**

1. **Introduction**

Usage of assembly languages is most natural way to program embedded devices. There are several types of instruction-set architectures. x86, RISC, CISC and RISC-V instruction-set architectures are the most known. There are different free assembly languages for different devices. For x86 based devices Netwide assembler or Yarn assembler can be used. For devices based on RISC based devices there are GNU assembler, AVR assembler. For RISC-V based devices can be used RISC-V assembler. This paper describes process of finding best assembler to design real-time operating system.

2. Material and Methods

AVR assembler is used for range of AVR RISC devices. Binutils package contains linker *ld* and *GNU assembler*. GNU assembler can be used for RISC-based single board computers, such as Raspberry Pi 3, 4 or for latest Raspberry Pi 5. Attiny85 microcontroller and PIC10F320 will be compared. Assembler languages will be analyzed.

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| **Operating System** | **Type** | **Written in** |
| Zephyr | real-time | C |
| FreeRTOS | real-time | C |

**3. Results**

Free assembly languages for different instruction sets are compared.

AVR assembly compilation is shown. Micro-controllers for AVR / PIC assemblers are analyzed.

**4. Conclusions and future work**

According to Free assembly languages overview that can be used and AVR PIC instruction analys the conclusion of the paper: AVR assembly language and RISC-V assembly languages will be best choice to design real-time operating system

**References:**

1. GNU Binutils Reference Manual, 2023

2. Atmel, ATTiny85 Datasheet,2018

3. Microchip, PIC10F320 Datasheet,2023

4. Linux Manual Pages

5. Design micro-controller module with target to use AVR/PIC assembler (Stanchev, Master Degree Thesis), 2023

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1. PhD Theme: Methods and Tools to develop a assembly-based operating system for embedded devices [↑](#footnote-ref-2)