Parallel Programming on Embedded Multicore System ESP32

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Abstract

The following documentation will focus on the principles of parallel programming in general and the mathematical background. In addition to the different parallel programming architectures, the various models for their implementation are also discussed. Moreover, in this thesis the prerequisites for mathematical calculation models, which are suitable for Parallel Programming, are elaborated.

For a practical example, the ESP32 microcontroller was chosen, an embedded multicore system. After a brief introduction to the hardware itself, further details of the project structure and the development of the application will be presented. Therefore, a short example will be explained to focus on the basics of parallel programming.

Finally, the aim of the project and the documentation is an automatic benchmark setup and a webfrontend result overview for visualization purposes, which will be discussed in more detail in the conclusion.

Declaration

I hereby certify that I have done the final thesis on my own, that I have completely and accurately stated all the aids I have used and identified everything individually, which was taken from the work of others unchanged or with modifications.

The topic of the submitted work was jointly with Mr. / Mrs. (...) (Bachelor and Master Thesis No. (...)).

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Chapter 1

Introduction

Multicore systems are becoming increasingly popular as part of digitization[1] and Industry 4.0 (German/EU) [2] [or 1] - also known as smart manufacoring in the USA [see 23, p1] - are playing an increasingly important role in data processing and process automation [see 27, p294] [or 22, p1]. On the other hand, in addition to efficiency in energy consumption, performance in terms of computation time is required [see 27, p294].

In fact, multicore hardware is not only exspecially for smart manufactoring. Nowerdays in almost every smart application like smart phones, smart watches or home automation we can find multicore embedded hardware platforms, which garantued high performance [see 4, p7], network connectivity, security and reliability [see 31, p5]. This field of application is also known as Internet of Things (IoT)[2].

Especially for embedded systems mathematical models as well as numerical solutions, which can be executed both simply and parallel, are suitable. The question arises to what extent parallel execution of different sub-tasks to calculate a problem [see 26, p4] increases the desired cost factor in terms of energy consumption [see 9, chapter 3] and computational efficiency [see 26, p4 Figure 3].

In order to develop an optimal solution, the hardware platform must be included in addition to the mathematical model. In this case, suitable prerequisites and characteristics can be worked out in order to enable an evaluation of "Parallel Computation Tasks on Embedded Multicore Systems".

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[1]add.: https://www.epicor.com/en-ae/resource-center/articles/what-is-industry-4-0/
[2]for additional information about Internet of Things, please see [15]

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Appendix A

Additional documents

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