Selected Features of ARM Cortex-Based STM32 Microcontrollers

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***Abstract*—This undergraduate thesis explores the features of the STM32 microcontroller based on the ARM Cortex core. The author reviews the ARM Cortex core, discusses programming techniques for microcontrollers, and develops several demonstration programs. The thesis covers the ARM Cortex variants, and introduces the STM32-Nucleo kit, including its peripherals and development tools. The author successfully developed several demonstration programs for the STM32 microcontroller, including GPIO, Timer, and serial communication programs. The work highlights the importance of embedded system programming and the increasing use of ARM Cortex-based microcontrollers. The author acknowledges the need for further learning to meet the demands of a professional career.**

***Index Terms*—STM32, Cortex ARM, microcontroller, programming, GPIO, Timer**

I. Introduction

The thesis provides an overview of the ARM Cortex core, its development history, and various ARM Cortex cores. It also introduces the STM32-Nucleo kit, detailing its peripherals and development tools. The author reviews the ARM Cortex core, covering several ARM Cortex variants, and discusses the importance of embedded system programming. The STM32-Nucleo kit is introduced as a development platform for STM32 microcontrollers, which includes various peripherals and development tools. The author aims to develop demonstration programs to showcase the capabilities of the STM32 microcontroller [1]. Related published studies provide context for the subject and methods [2], [3], [4], [5], [6], [7], [8], [9], [10]. These contextual works were selected for this English summary; they are not asserted to appear in the original thesis bibliography.

II. Methods

The author reviews the ARM Cortex core, discussing its architecture and features. Programming techniques for microcontrollers are also covered, including the use of GPIO, Timer, and serial communication. The STM32-Nucleo kit is used as a development platform to implement and test the demonstration programs. The author develops several demonstration programs, including GPIO, Timer, and serial communication programs, to showcase the capabilities of the STM32 microcontroller [1].

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III. Results

The author successfully developed several demonstration programs for the STM32 microcontroller, including GPIO, Timer, and serial communication programs. The GPIO program demonstrates basic input and output functionality, the Timer program showcases the ability to measure time intervals, and the serial communication program illustrates the capability to transmit data over a serial interface. These programs are implemented using the STM32-Nucleo kit, which provides the necessary peripherals and development tools [1].

IV. Discussion

The thesis highlights the importance of embedded system programming and the increasing use of ARM Cortex-based microcontrollers. The author acknowledges the need for further learning to meet the demands of a professional career. The demonstration programs developed by the author provide a foundation for understanding the capabilities of the STM32 microcontroller. The work contributes to the knowledge base of ARM Cortex-based microcontrollers and their applications in embedded systems [1].

V. Conclusion

The author concludes that embedded system programming requires a high level of technical expertise and that the study of ARM Cortex-based microcontrollers offers many opportunities for engineers and helps to improve the technical skills of Vietnamese engineers. The work provides a solid foundation for further research and development in the field of embedded systems and ARM Cortex-based microcontrollers. The report also documents practical GPIO, timer, and serial-communication demonstrations on the STM32-Nucleo platform [1].

References

[1] TẠ THỊ HƯƠNG, ”Selected Features of ARM Cortex-Based STM32 Microcontrollers,” internal undergraduate thesis (original in Vietnamese), Thai Nguyen University of Information and Communication Technology, 2024.

[2] A.V. Osintsev et al., ”Performance Analysis of Microcontrollers with Core Cortex-M3,” Problems of advanced micro- and nanoelectronic systems development, 2022. doi:10.31114/2078-7707-2022-3-123-128.

[3] Aleksey Egorov et al., ”Hardware-Software Complex for Functional and Parametric Tests of ARM Microcontrollers STM32F1XX,” MATEC Web of Conferences, 2016. doi:10.1051/matecconf/20167901031.

[4] Patryk Chaber et al., ”Fast Analytical Model Predictive Controllers and Their Implementation for STM32 ARM Microcontroller,” IEEE Transactions on Industrial Informatics, 2019. doi:10.1109/tii.2019.2893122.
[5] K. S. Kuznetsov et al., ”Virtual Laboratory for Studying and Programming Stm32 Microcontrollers,” Intellekt. Sist. Proizv., 2021. doi:10.22213/2410-9304-2021-4-98-110.
[6] Oguzhan ALDEMIR et al., ”Integration of STM32 Microcontroller with Arm Cortex Architecture into the 8-Bit Measurement Circuit Customized for Real-Time Data Acquisition on Propeller Shaft to Increase Data Speed and Accuracy,” The Eurasia Proceedings of Science Technology Engineering and Mathematics, 2023. doi:10.55549/epstem.1408850.
[7] Mykola Shcherbyna, ”Improving Code Compression for Arm Cortex M Microcontrollers Using Pre- Filtering,” Vìsnik Nacìonal′nogo unìversitetu ”L′vìvs′ka polìtehnìka”. Seriâ Ìnformacìjnì sistemi ta merežì, 2023. doi:10.23939/sisn2023.14.225.
[8] A. E. Vasil’ev et al., ”The Development and Use of Data Acquisition and Control Systems Based on Arm Microcontrollers,” Measurement Techniques, 2015. doi:10.1007/s11018-015-0693-3.
[9] Shan Ying Cheng et al., ”Driver of CAN BUS Based on ARM Cortex-M3,” Advanced Materials Research, 2014. doi:10.4028/www.scientific.net/amr.1044-1045.1135.
[10] Petr Ivanovich Alexeevskiy, ”TRAINING STUDENTS PROGRAMMING USING STM32 DISCOVERY DEVELOPMENT KITS,” Pedagogical Education in Russia, 2018. doi:10.26170/po18-08-02.