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Microcontrollers for Handheld Devices

Introduction

Microcontrollers are solitary chip microcomputers designed with very-large-scale integration (VLSI) architecture. They are used to control embedded systems in various types of technologies, such as office machines, robots, motor vehicles, home appliances, and other gadgets, such as mobile devices. The basic components are memory, peripherals and a processor. Microcontrollers are currently available in the market in different word lengths such as 4bit, 8bit, 64bit, and 128bit [1]. This paper is a review of microcontrollers for handheld devices.

Commercial Applications of Microcontrollers

Industrial Applications

Some commercial applications include assembly line automation, processing equipment such as mixers, vessels, heaters, etc., condition-monitoring equipment and systems, advanced process control, which involves simulation and optimization, analytical equipment that includes process electrochemical, gas chromatographs for industrial manufacturing and related products, etc.

Consumer Products

Applications related to consumer products interact with power tools, garage door openers, medical testing devices, traffic lights, portable devices such as gaming consoles, etc. [2]. Gaming consoles are devices that contain microcontrollers with functions such as video signal generation, sound, motion as in vibration, etc., depending on the nature of the game. All processed in real time [3].

Two common brands used for prototyping a handheld device are the ARM mbed platform and the Arduino platform. Their cost varies, starting from 80 and 25 USD respectively [4][5]. Both platforms can be programmed in C++ and have low power consumption. The mbed platforms use ARM Cortex M0, M3, and M4 microcontrollers, which are generally much faster, have more memory and functionality. The Arduino platforms are made by Atmel. They are memory limited and are based on Atmega328

microcontrollers, except for the Arduino Mega which is based on Atmega2560 and the newer Arduino Due which is based on ARM Cortex M3 [6].

Underlying Technology of Microcontrollers

Microcontrollers are embedded controllers that have a memory, input/output circuitry (peripherals) and a central processor. There are two general types of hardware interfaces. First, the communication interfaces, which are the peripherals such as universal serial bus (USB), inter-integrated circuit (I2C), serial peripheral interface (SPI), universal asynchronous receiver/transmitter (UART), and other interfaces interacting within the handheld device. These interfaces determine how much space the microcontroller needs to support them. Second, the digital inputs and outputs, analog in and out signals, as well as pulse width modulation (PWM) signals, etc. The latter dictates the number of pins required by the microcontroller. The software architecture and processing power are important components. They set a standard for the amount of computing power required by the type of architecture and frequency of the microcontroller. The architecture depends on the application appropriate for the design and the software algorithms implemented on the device. These architectures range from 4bit to 128bit. The flash memory and random access memory (RAM) are critical components of any microcontroller and its optimal performance. These memories can be estimated using the software architecture and the communication peripherals included in the application [7].

Building Blocks of a Microcontroller

Microcontrollers are built on a silicon base that has extra elements added to create millions of semiconductor devices. The devices are arranged and connected to form combinational logic gates, which perform mathematical operations. The semiconductor devices are arranged to form memory, such as RAM, using sequential logic. Microcontroller designers use these building blocks to create various parts of the microcontroller central processing unit (CPU), such as arithmetic logic unit (ALU), CPU registers, buses, and memory [8].

REFERENCES

- [1] Administrator. (2015, August 9). Microcontroller Types and Applications [Online]. Available: <http://www.electronicshub.org/microcontrollers/>
- [2] P. Leara. (2011, March 16). Microcontrollers: Where the Real World Meets the Digital [Online]. Available: <http://www.roundedcube.com/Blog/2011/microcontrollers-where-the-real-world-meets-the-digital>
- [3] M. Pandina. (2017, February 19). Uzebox News: About [Online]. Available: <http://belogic.com/uzebox/index.asp>
- [4] (2017). Amazon [Online]. Available: <https://www.amazon.com/SparkFun-MBED-005-1-mbed-LPC1768-Development/dp/B004G4XU94>
- [5] (2017). Amazon [Online]. Available: https://www.amazon.com/s/ref=nb_sb_noss_1?url=search-alias%3Dcomputers&field-keywords=arduino+uno
- [6] S. Feingold. (2013, August 22). What Differences Are There Between Mbed and Arduino Nano? Pros and Cons? [Online]. Available: <https://www.quora.com/What-differences-are-there-between-mbed-and-Arduino-nano-Pros-and-cons>
- [7] J. Beningo. (2013, April 07). 10 Steps to Selecting a Microcontroller [Online]. Available: <http://www.edn.com/electronics-blogs/embedded-basics/4411480/1/10-steps-to-selecting-a-microcontroller>
- [8] S. Labs. (2013, October 14). How Microcontrollers Work [Online]. Available: <https://stratifylabs.co/embedded%20design%20tips/2013/10/14/Tips-How-Microcontrollers-Work/>