PAMANTASAN NG LUNGSOD NG MAYNILA
(University of the City of Manila)
Intramuros, Manila

MICROPROCESSOR (LECTURE)

Activity No. 2
Microprocessor and its Architecture

Score

Submitted by:
Laurente, Queenie D.
S 1:00-7:00 / CPE 0412-2

Date Submitted
25/11/2023

Submitted to:

Engr. Maria Rizette H. Sayo

Instruction

A. Briefly describe the enumerated categories.
    1. Microcontrollers are categorized according to the following:
        a. Number of bits
        b. Memory
        c. Instruction set
        d. Applications
    2. Problems arise on the electrical characteristics of a bus. Discuss how noise immunity differs from bus loading.
    3. How is bus buffering technique being done?
    4. Why is flags register necessary in the operation of the microprocessor?
B. Cite your references below.

Answer

1. Microcontrollers are categorized according to the following:

a. Number of bits

Binary digit, commonly denoted to as bit, refers to the smallest unit of binary information that serves as the foundation for digital information processing [1]. Binary numbers signifies 1 for on or true and 0 signifies off or false, and a bit represents one of these two states. The types of microcontrollers according to the number of bits include 8-bit MC, 16-bit MC, and 32-bit MC. The 8-bit MC is used to execute arithmetic and logical operations like addition, subtraction, multiplication, and division with 8-bit data processing (e.g., Intel 8031, 8051). Meanwhile, the 16-bit MC is also used to implement arithmetic and logical operations but with increased accuracy and better performance (e.g., Intel 8096). On the other hand, the 32-bit MC requires 32-bit instructions to provide superior processing speed, to handle multiple peripherals, and to be used in automated devices such as office machines, implantable medical appliances, computer applications, and more [2].

b. Memory

Memory stores the program of a microcontroller [3]. There are two types of memory: RAM (Random Access Memory) that is capable of reading and writing data and ROM (Read Only Memory) that is primarily for storing programs as read-only data. The types of microcontrollers according to memory are external memory MC and embedded memory MC. The external memory MC lacks on-chip program memory (e.g., Intel 8031). Contrarily, the embedded memory MC incorporates on-chip program and data memory, counters, timers, interrupts, and I/O ports (e.g., Intel 8051) [2].

c. Instruction set

An instruction set comprises commands designed for a central processing unit (CPU) in its machine language [4]. It may encompass either the complete range of instructions for a CPU or a subset to enhance performance in specific scenarios. The types of microcontrollers according to instruction set are CISC and RISC. CISC stands for complex instruction set computer. It enables users to execute a single instruction instead of multiple simpler instructions. In contrast, RISC stands for reduced instruction set computers. It shortens operation time by reducing the clock cycle per instruction [5].

d. Applications

Microcontrollers find diverse applications across various fields. The types of microcontrollers according to application include tits use in day-to-day life devices, in industrial control devices, and in metering and measurement devices. Microcontrollers are employed in day-to-day devices for applications such as light sensing and control, temperature monitoring, and fire detection and safety. Additionally, microcontrollers play a crucial role in industrial control devices, including instrumentation and process control. Furthermore, microcontrollers contribute to metering and measurement devices, such as volt meters, measuring of revolving objects, current meters, and handheld metering systems [5].

2. **Problems arise on the electrical characteristics of a bus. Discuss how noise immunity differs from bus loading.**

Noise immunity refers to the capacity of a device or system to carry out its operations effectively in the presence of interference or noise [6]. In other words, it is the ability of the bus system to resist and tolerate external electrical noise brought by various factors like electromagnetic interference (EMI), radio-frequency interference (RFI), and others. It is directly influenced by various factors including differential signaling, shielding, grounding, twisted pair configuration, etc. On the other hand, bus loading refers to the effect of connecting devices or components to the bus, influencing its electrical characteristics [7]. As more devices are connected to a bus, the overall electrical load increases, which can lead to issues such as signal degradation, signal reflections, and higher power consumption. The difference between the two concepts is that noise immunity focuses on the ability of the bus to resist external disturbances, while bus loading considers the impact of the devices connected to the bus on its electrical characteristics. Both of these aspects are critical in designing a reliable and efficient bus system to ensure proper electrical functionality.

3. **How is bus buffering technique being done?**

Bus pertains to a commonly used transmission system for data and address in binary form [8]. Meanwhile, buffer signifies a circuit or component employed to temporarily store and handle data during instruction processing to optimize the data transfer between the components [9]. The bus buffer technique involves retaining the data present on the bus at a given moment [10]. It is used to overcome issues related to bus loading and signal integrity in digital systems. Bus buffering is done through the use of integrated circuit (IC) buffers, which are placed along the bus to isolate different segments when devices heavily load the bus. These components reduce the load in the source to improve signal and prevent degradation. They can also perform tasks such as voltage level translation and impedance matching. Finally, buffers diminish the loading effects caused by connecting numerous devices to the bus, ensuring efficient signal transmission.

4. **Why is flags register necessary in the operation of the microprocessor?**

Flag register is a special-purpose register that undergoes changes in its flag bits, transitioning between 0 and 1 based on the outcome of arithmetic or logical operations [11]. It consists of individual bits, each representing a specific condition or status. These flags provide important information about the outcome of arithmetic and logic operations. Flags represent a specialized form of register capturing the state of a microprocessor's computation. There are numerous type of flags including the carry flag that indicates carry or borrow upon adding or subtracting, sign flag that indicates if the number is positive or negative, an overflow flag that indicates an excess to the word limit, parity flag that indicates if the number is odd or even, and the zero status flag that indicates if a number is zero or non-zero [12]. These flags are essential since they enable the processor to make decisions based on the outcome of operations, facilitates conditional branching, and provides valuable information about the state of the processor, which contributes to the execution of efficient and controlled program logic. These flags provide information about the current status of the processor. They are also updated to reflect conditions such as overflow, carry, and zero upon undergoing arithmetic operations, logical operations, and comparison operations. Moreover, these flags are helpful in interrupt handling and debugging purposes.

References

[1] IONOS editorial team, “What is a bit? Bits and bytes explained,” *IONOS Digital Guide*, Dec. 08, 2022. https://www.ionos.com/digitalguide/websites/web-development/what-is-a-bit/
[2] L. Ashrit, “Microcontroller – Classification, Architecture, Application, Advantage,” *electricalfundablog.com*, Jan. 16, 2020. https://electricalfundablog.com/microcontroller-classification-architecture/#google_vignette
[3] “Memory Type (RAM & ROM) | Toshiba Electronic Devices & Storage Corporation | Asia-English.” https://toshiba.semicon-storage.com/ap-en/semiconductor/knowledge/e-learning/micro-intro/chapter2/memory-type-ram-rom.html
[4] P. Kirvan, “instruction set,” *WhatIs.com*, May 23, 2022. https://www.techtarget.com/whatis/definition/instruction-set
[5] Administrator, “Microcontroller types and applications,” *ElectronicsHub*, Mar. 13, 2023. https://www.electronicshub.org/microcontrollers/
[6] P. K. Chatterjee *et al.*, “Integrated circuits,” in *Elsevier eBooks*, 2002, pp. 20–113. doi: 10.1016/b978-075067291-7/50022-4.
[7] GeeksforGeeks, “Bus organization of 8085 microprocessor,” *GeeksforGeeks*, May 06, 2023. https://www.geeksforgeeks.org/bus-organization-of-8085-microprocessor/
[8] “What is bus in microprocessor?,” *Bench Partner*, Jan. 22, 2022. https://www.benchpartner.com/q/what-is-bus-in-microprocessor
[9] “What is buffer in microprocessor? - Online Interview...,” *Onlineinterviewquestions.com*. https://www.onlineinterviewquestions.com/what-is-buffer-in-microprocessor/
[10] “What does ‘address data multiplexing’ and ‘bus buffering’ mean?,” *Super User*. https://superuser.com/questions/258030/what-does-address-data-multiplexing-and-bus-buffering-mean
[11] “Flag register of 8086 microprocessor.” https://www.tutorialspoint.com/flag-register-of-8086-microprocessor
[12] C. Mathie, “What is a flag in a microprocessor?,” *Techwalla*, Dec. 06, 2010. https://www.techwalla.com/articles/what-is-a-flag-in-a-microprocessor