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

MICROPROCESSOR (LECTURE)

Activity No. 1
Review of Terminologies

Score

Submitted by:
Malabago, Antonio Emmanuel C.
S 1:00-7:00PM / CPE 0412-2

Date Submitted
28-09-2023

Submitted to:
Engr. Maria Rizette H. Sayo

Instruction:

A. Define and discuss the following terminologies related to microprocessor systems:
   1. MPU

      A microprocessor is a central unit component embedded into a silicon chip that can process logical instructions and processes, including mathematical operations, device communication, input/output management, and others. These are usually categorized based on the number of instructions they can process for a specified time, frequency, or clock speed at which they operate, and number of bits consumed per instruction. The relative computing power of a microprocessor largely depends on the number of integrated circuits it holds (Rouse, 2012).

      During its operation, the microprocessor executes the machine language instructions and performs three different functionalities: ALU (Arithmetic Logic Unit), operations, moving data from one register to another, and jumping to the next set of instructions. Moreover, microprocessors are consisting of different parts that perform different operations. These includes an address bus that tells the address to memory, a data bus that can send or receive data to or from memory, a read/write line that retrieves or modifies data in the addressed location, a clock line that provides clock pulse sequence, and reset line that restarts the execution cycle (Brain & Pollette, 2021).

      In 1971, Intel 4004/4040 was introduced as the first 4-bit microprocessor with a clock speed of 740kHz, comprising 2300 transistors, and can process up to 60k instructions per second. It was superseded by 2nd generation 8-bit microprocessors such as Intel 8085 and Motorola 6800 from 1973 to 1978. From 1979 to 1980, the same companies leveraged HMOS technology to develop the 3rd generation 16-bit microprocessors, resulting in higher speeds (2.5M instructions per second) and larger chip densities (29k transistors). Then, HMOS fabrication was introduced in developing 32-bit 4th generation processors such as Intel 80386 and Motorola 68020. From 1995 until now, 64-bit 5th generation 64-bit processors were invented with GHz clock speeds and multi-level caches (GeekforGeeks, 2023).

   2. MCU

      A microcontroller is a special-purpose computer interfaced in a single integrated chip designed to perform only one specific task or application. It is heavily utilized for automating processes in embedded systems and electronic devices. Microcontrollers are commonly characterized by their economical size/cost, low power consumption, purpose-driven architecture, dedicated input/output devices, capability to control features/actions, read-only memory (ROM) for program storage, and limited computing functions (Rouse, 2016).

      Since microcontrollers are computers, they can process specific instructions, collect user/external data, and show the program results/outcomes. They serve as a medium for microprocessors to communicate information from or to the human environment. Microcontrollers can be composed of different parts depending on their application. The CPU or MCU executes purpose-specific instructions, RAM for temporary storage of variables, input devices that retrieve data, output devices that display results, and I/O devices that can perform both input and output operations (Brain, 2023).

      Gary Boone invented the first microcontroller, TMS18002NC, to manufacture a multi-function calculator with 3k bits of program memory and 128 bits of access memory. Due to high demand, Boone introduced the TMS100 microcontroller chip, primarily used for calculators and later sold to the electronics industry with different RAM and ROM sizes. In 1976, Intel released 8048 in 1976, while 8051 in 1980 was considered the market's longest-lived microcontroller. During the 1990s, Atmel and Microchip introduced flash memory technology where microcontroller ROM memory can be erased and reprogrammed. Currently, MCUs such as AVR and PIC are used for gadgets and consumer devices that are comparatively smaller and more powerful than their earlier versions (Toshiba, n.d.).

3. Features of microprocessor and microcontroller

Below are the relevant features of microprocessor:

- *Microprocessors have an external memory interface*. This enables new MPU models to access external memory devices and peripherals through an AXI interconnect for memory flexibility of system designs.
- *Microprocessors can perform parallelization*. This means that MPU can simultaneously process multiple parallel I/O or input/output operations, allowing system design to achieve higher write speeds and bandwidth.
- *Microprocessors have instruction cycle timers*. The instruction cycle allows MPU to perform all operations efficiently by overlooking the order in which instructions are processed and determining the total processing time for each step: fetch, decode, execute, and store.
- *Microprocessors integrate Von-Neumann Architecture.* It is a computer architecture based on stored program computers, which can be used to perform a variety of processes and store different programs/applications within them.
- *Microprocessors have debugging with interrupt features*. The latest MPUs have embedded debug and test circuitry for downloading code and enable single stepping through instructions that assist developers in debugging.

Below are the relevant features of microcontroller:

- *Microcontrollers have pins for programming and variable memory*. MCU has several I/O pins for properly connecting to other components such as sensors, actuators, displays, and communication modules.
- *Microcontrollers can reset its processor*. This means that MCU can start or restart currently running programming without deleting, which offers control and flexibility in executing and testing software code.
- *Microcontrollers have a device clocking central processor*. The system clock drives the core operation within the MCU and determines the frequency and reference timing at which the processing unit performs tasks such as fetch, decode, and execute.
- *Microcontrollers integrate Harvard Architecture*. Contrary to microprocessors, MCU follows computer architecture with two allocated buses for instruction and processes that enable devices to access instructions and data simultaneously.
- *Microcontrollers require less cost and power*. MCUs are primarily utilized in embedded applications since their initial cost and power consumption are less than microprocessors, making them a viable option for controlling automated devices.

4. Applications of microprocessor and microcontroller

MPU Applications	MCU Applications
1. Personal computers	1. Home appliances
2. Complex industrial controllers	2. Gadgets and devices
3. Military applications	3. Automobile engines
4. Defense systems	4. Control systems
5. Computation systems	5. System automation
6. Accounting system	6. Wearable devices
7. Automotives control systems	7. Smart home devices
8. Medical devices	8. Security system
9. Telecommunications	9. Traffic management
10. Aerospace and avionics	10. Energy management
11. Space exploration	11. Arcade machines
12. Weather forecasting	12. Electronic voting machines
13. Audio processing	13. Environmental monitoring
14. Robotics and automation	14. Smart grids
15. Scientific research	15. Biomedical implants

B. Cite your References below.

Brain, M. (2023). How microcontrollers work. *HowStuffWorks*. https://electronics.howstuffworks.com/microcontroller1.htm

Brain, M., & Pollette, C. (2021). How microprocessors work. *HowStuffWorks*. https://computer.howstuffworks.com/microprocessor.htm

GeeksforGeeks. (2023). Evolution of microprocessors. *GeeksforGeeks*. https://www.geeksforgeeks.org/evolution-of-microprocessors/

Rouse, A. P. B. M. (2012, June 25). *What is a Microprocessor? - Definition from Techopedia*. Techopedia. https://www.techopedia.com/definition/2874/microprocessor

Rouse, A. P. B. M. (2016, December 21). *What is a Microcontroller? - Definition from Techopedia*. Techopedia. https://www.techopedia.com/definition/3641/microcontroller

Toshiba Electronic Devices & Storage Corporation. (n.d.). *History of Microcontrollers*. https://toshiba.semicon-storage.com/ap-en/semiconductor/knowledge/e-learning/micro-intro/chapter2/history-microcontroller.html

Williams, L. (2023). Difference between Microprocessor and Microcontroller. *Guru99*. https://www.guru99.com/difference-between-microprocessor-and-microcontroller.html