American International University - Bangladesh (AIUB)
Faculty of Engineering
Department of Electrical and Electronic Engineering (EEE)

Course Name:	Microprocessor and Embedded Systems	**Course Code:**	EEE 4103
Semester:	Spring 23-24	**Term:**	Mid
Faculty Name:	Md Sajid Hossain	**Assignment #:**	01

Course Outcome Mapping with Questions

Item	COs	POIs	K	P	A	Marks	Obtained Marks
Q1	CO2	P.a.4.C3	K4	P1, P3, P7		10	

Student Information:

Student Name:	**TRIDIB SARKAR**	**Section:**	**F**
Student ID #:	**22-46444-1**	**Department:**	**BSC in CSE**

Submission Information:

Submission Date:	**04-Feb-2024**	**Due Date:**	
Student ID #:	**22-46444-1**	**Department:**	**BSC in CSE**

Marking Rubrics (to be filled by Faculty):

Problem #	Excellent [5]	Proficient [4]	Good [3]	Acceptable [2]	Unacceptable [1]	No Response [0]	Secured Marks
	Detailed unique response explaining the concept properly and answer is correct with all works clearly shown.	Response with no apparent errors and the answer is correct, but explanation is not adequate/unique.	Response shows understanding of the problem, but the final answer may not be correct	Partial problem is solved; response indicates part of the problem was not understood clearly.	Unable to clarify the understanding of the problem and method of the problem solving was not correct	No Response/ (Copied/identical submissions will be graded as 0 for all parties concerned)	
1							
Comments						Total marks (10)	

Question # 1: Complete Table 1 after going through the datasheet of the specified microcontrollers.

Table 1

Specifications	ATMega328P	STM32F401RE	ATMega2560	PIC33FJ32GP302
Manufacturer Name	ATMEL	STMicroelectronics	ATMEL	MICROCHIP
Number of pins	28	81	86	28
Processing Speed (MIPS)	up to 20MHz	up to 84MHz	up to 16MHz	up to 40MHz
Program flash memory (bytes)	32K Bytes	512K Bytes	256K Bytes	32K Bytes
SRAM	2K Bytes	96K Bytes	8K Bytes	4K byes
ADC Resolution	10 Bit	12 Bit	10 Bit	10 Bit
Communication Interfaces	USART interface TWI interface SPI interface	3 x I2C interfaces 3 x USARTs 4 x SPIs SDIO interface USB 2.0/host/OTG	USART interface TWI interface SPI interface	PMP interface 2 x USARTs 4 x SPIs CAN Module I2C Module DCI Module

The unit prices of the above mentioned MCUs are as follows: (1 USD = 108.50 BDT)

	ATMega328P	STM32F401RE	ATMega2560	PIC33FJ32GP302
Price	$2.70	$4.10	$18.86	$4.02

X Company in Bangladesh is trying to develop an affordable shop security system and they have shortlisted the listed 4 MCUs as possible candidates for their system CPU. The required minimum specifications for their intended design for the CPU are given below:

Minimum Clock Speed	16 MHz
Minimum SRAM	8 Kbytes
Minimum ADC Resolution	10-bit
Minimum Program Memory	32 KBytes
Minimum Number of PWM Channels	5

Being a design engineer at X Company, you have been given the responsibility to select the most suitable IC from the list for the security system design. Please select an IC from the list to design an **affordable** system and justify your answer with proper reasoning.

I have decided to choose the **STM32F401RE** because it satisfies all of the minimum requirements for our project. The Atmega2560 also meets the minimum requirements for the system, but I have chosen the STM32F401RE because it offers similar capabilities at a **lower unit price.**

Let's break down the reason:

- **Clock Speed (MHz):** The STM32F401RE operates at up to 84MHz, which is significantly higher than the required minimum of 16MHz. This provides enough processing power for the security system and allows for potential future performance enhancements.

- **SRAM**: The STM32F401RE offers 96K Bytes of SRAM, well above the minimum requirement of 8 Kbytes. This ample SRAM capacity is essential for buffering data and executing tasks efficiently in a security system.

- **ADC Resolution:** While the minimum ADC resolution required is 10-bit, the STM32F401RE features a 12-bit ADC resolution. This higher resolution allows for more accurate analog-to-digital conversions, which can be crucial for various sensor inputs in a security system.

- **Program Memory**: The STM32F401RE provides 512K Bytes of program flash memory, exceeding the minimum requirement of 32 K Bytes. This ample program memory ensures there's enough space for the system's firmware and any potential future updates or additions.

- **PWM Channels:** The STM32F401RE offers several PWM channels, which are essential for controlling various components in a security system, such as alarms, cameras, or sensors. Having more PWM channels (5 or more) is advantageous for flexibility in system control.

- **Communication Interfaces**: The STM32F401RE comes with a wide range of communication interfaces, including I2C, USART, SPI, SDIO, and USB 2.0/host/OTG. These interfaces allow for easy integration with different sensors, communication modules, and external devices, enhancing the system's versatility.

- **Price**: The price of the STM32F401RE at $4.10 is reasonable and falls within an affordable range for a security system's CPU.

In summary, the STM32F401RE not only meets but also exceeds the minimum requirements for clock speed, SRAM, ADC resolution, program memory, and PWM channels. It offers a wide array of communication interfaces, making it a versatile choice for a shop security system. Considering its capabilities and the affordable price point, the STM32F401RE is a suitable and cost-effective choice for X Company's security system design.