

	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:	Fall 2023-24	Term:	Mid	
Faculty Name:	Protik Parvez Sheikh	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	
Total:						10	

Student Information:

Due Date:	11/10/2023	Submission Date:	16/10/2023
Student Name:	MD. ZAMIUL SADIK NAHIN		
Student ID #:	20-44228-3	Department:	CSE
		Section:	L

Marking Rubrics (to be filled by Faculty):

Problem #	Excellent [9-10]	Proficient [7-8]	Good [4-6]	Acceptable [2-3]	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 or not solved.	Unable to clarify the understanding of the problem and method of the problem solving was not correct	No Response/ copied from others/identical submissions with gross errors/image file printed	
Comments							Total Marks (10)

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

Table 1

Specifications	ATMega328P	STM32F401RE	ATMega2560	PIC24FJ64GA004
Architecture Type	8-bit AVR	32-bit ARM CortexM4	8-bit AVR	16-bit PIC24
Maximum Clock Speed	20 MHz	84 MHz	16 MHz	32 MHz
Program Flash Memory (Kbytes)	32 Kbytes	512 Kbytes	256 Kbytes	64 Kbytes

Specifications	ATMega328P	STM32F401RE	ATMega2560	PIC24FJ64GA004
SRAM (Kbytes)	2 Kbytes	96 Kbytes	8 Kbytes	8 Kbytes
ADC Resolution	10-bit	12-bit	10-bit	10-bit
Operating Voltage Range (V)	1.8V to 5.5V	1.7V to 3.6V	1.8V to 5.5V	2.0V to 3.6V
Number of PWM Channels	6	4 (timers with up to 4 channels each)	15 (6 timers with up to 4 channels each, and one high-speed timer with up to 2 channels)	5 (with up to 4 channels each)
Communication Interfaces	USART, SPI, I2C (TWI)	USART, SPI, I2C (TWI) USART, SPI, I2C, CAN, USB	USART, SPI, I2C (TWI)	UART, SPI, TWI, I2C (I2C with SMBus/PMBus)

The unit prices of the above mentioned MCUs are as follows: (1 USD = 108 BDT)

	ATMega328P	STM32F401RE	STM32F412ZGT6	ATMega2560	PIC24FJ64GA004
Price	\$2.70	\$4.10	\$5.99	\$18.86	\$4.02

X Company in Bangladesh is trying to develop an affordable shop security system and they have shortlisted the listed 5 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	32 MHz
Minimum SRAM	8 Kbytes
Minimum ADC Resolution	10-bit
Minimum Program Memory	32 KBytes
Minimum Number of PWM Channels	6
Required Serial Communication Interfaces	SPI, TWI, USART

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 and efficient system and justify your answer with proper reasoning.

Answer:

We might evaluate all of the registered MCUs to determine which, in light of the core requirements touted by X company, is ideal for their shop security framework strategy. Now let's start making distinctions according to clock speed. The clock speed for the STM32F401RE, PIC24FJ64GA004 & STM32F412ZGT6 is 32 MHz, which is adequate. The ATmega328P, ATmega2560 does not have the clock speed 32 MHz, so in this case X Company requirement a least clock speed of 16 MHz, it might not be the perfect choice. Let's move on to SRAM. ATmega2560 & PIC24FJ64GA004 have fully fulfilled the requirement of 8Kbytes SRAM. On the other hand, STM32F401RE & STM32F412ZGT6 have SRAM more than our requirement but ATmega328P does not fulfill our requirement of 8Kbytes SRAM. All the given MCUs have a minimum of 10-bit ADC resolution. All the given MCUs have the minimum program memory of 32 Kbytes so we can say we can use any MCUs in terms of program memory. Let's move on to PWM channels The PIC24FJ64GA004 has 5 PWM channels, ATmega328P has 6 PWM channels, ATmega2560 has 15 (6 timers with up to 4 channels each, and one high-speed timer with up to 2 channels), STM32F401RE has 4 channels & STM32F412ZGT6 have 5 channels. From this discussion we can find that ATmega328P & ATmega2560 have the minimum channel requirement. All the MCUs have the support of given communication interfaces so in terms of communication interfaces we can use any of those interfaces. But in the end, we must decide on one single MCU for the shop security framework. From the discussion we find that no MCU fulfills our company requirements but if we can reduce the PWM channel requirement then we can use PIC24FJ64GA004 & STM32F412ZGT6 because these 2 MCUs have 5 channels but they have fill other requirements. If we make distinction according to cost, we can use PIC24FJ64GA004 because it cost \$4.02 but the other one cost \$5.99 that is more costly.