Week 5: Design Matrix & AHP Methodologies

ECE 411 Industry Design Processes Product Design Specification (PDS)

Team 5: Mohamed Ghonim, Ibrahim Binmahfood, Joshua Hobby, Mohamed Ashkanani

---

Which Microcontroller Should We Use?

We have decided to list options of microcontrollers for our decision matrix.

Identifying alternatives:

1. ATMEGA328P-AU (https://www.digikey.com/en/products/detail/microchip-technology/ATMEGA328P-AU/1832260)
2. ATMEGA168-20PU (https://www.digikey.com/en/products/detail/microchip-technology/ATMEGA168-20PU/735446?s=N4IgTCBcDaIIIBUCyBRA4nAjANgBwFowAGABQFUQBdAXyA)
3. RP2040 (https://www.mouser.com/ProductDetail/Raspberry-Pi/RPI-Chip-RP2040-7-500?utm_medium=online&utm_content=model&utm_campaign=mouser&qs=QNEnbhJQKvaZH1bqQMV2YA%3D%3D&utm_source=snapedaonline)

Our decision matrix is based on four criteria:

1. Price - The overall cost of the microcontroller.
2. I/O Pins - The number of pins available for input and output.
3. Accessibility/Interface - Variety of options to connect, i.e. I2C, SPI, UART etc.
4. Memory - The KB size in memory for each device.

	RP2040	ATMEGA328P-AU	ATMEGA168-20PU
Price	$1.25	$2.86	$4.34
#I/O pins	30	27	23
Accessibility	3 options	4 options	6 options
Memory	32	32	16

Table 1.1: This table represents all the numbers which relate to the specification of microcontroller.

1. Make a Decision Matrix of this decision.

		RP2040	ATMEGA328P-AU	ATMEGA168-20PU
Price	5	5	4	2
#I/O pins	4	4	3	2
Accessibility	3	1	2	3
Memory	2	3	3	2
Score		50	44	31

Table 1.2: Initial decision matrix.

Analytical Hierarchy Process (AHP)

Selecting a microprocessor for our keyless door lock.

1	Equal
3	"Moderately" more important
5	"Strongly" more important
7	"Very strongly" more important
9	"Extremely" more important

Table 2.1. Pair-wise comparison of each criterion for relative importance. (Used for AHP)

1. Now take that Decision Matrix from above and use AHP instead using the same criteria and alternatives

		RP2040	ATMEGA328P-AU	ATMEGA168-20PU
Price	0.49	0.48	0.21	0.31
#I/O pins	0.31	0.38	0.34	0.29
Accessibility	0.13	0.23	0.31	0.46
Memory	0.07	0.40	0.40	0.20
Score		0.41	0.27	0.32

Table 2.2: Results of AHP

Additional tables used in decision:

	Price	#I/O pins	Accessibility	Memory
Price	1	5	3	3
#I/O pins	0.2	1	5	7
Accessibility	0.3333	0.2	1	3
Memory	0.3333	0.1429	0.3333	1

Table 3.1 Comparison of criteria

	Price	#I/O pins	Accessibility	Memory	Mean	Weight
Price	1	5	3	3	2.5900	0.4943
#I/O pins	0.2	1	5	7	1.6266	0.3104
Accessibility	0.3333	0.2	1	3	0.6687	0.1276
Memory	0.3333	0.1429	0.3333	1	0.3549	0.0677

Table 3.2: Averaged and weighted comparison

	RP2040	ATMEGA328P-AU	ATMEGA168-20PU
Price	$1.25	$2.86	$4.34
#I/O pins	30	27	23
Accessibility	3 options	4 options	6 options
Memory	32	32	16

Table 3.3: List of values found on datasheets

Normalized	RP2040	ATMEGA328P-AU	ATMEGA168-20PU
Price	0.477	0.209	0.314

Table 3.4: This represents the 1st criteria in the list “Price” after getting normalized.

Questions:

- *Did you get the same final result?*

  Yes, The Raspberry Pi microcontroller won out with the highest rating for both methods. Second place changed though, as the ATMEGA168 overtook the ATMEGA328P after normalizing. We may have given too much weight to the price though considering we are only talking about a few dollars. If this was being mass produced on a large scale this would be an accurate representation of which product we should use.

For the Decision Matrix Table, the final result was as following:

1 - RP2040

2 - ATMEGA328P-AU

3 - ATMEGA168-20PU

For the AHP, the final result was as following:

1 - RP2040

2 - ATMEGA168-20PU

3 - ATMEGA328P-AU