Team 7: Birdwatch Feeder Project

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Our group chose to decide on the microcontroller for our birdwatch feeder project that best meets the needs of our project. We looked into four different microcontrollers: ESP32, ATMEGA 32P, PI PICO, and an FPGA. We evaluated these microcontrollers through seven different categories: familiarity, cost, ease of use, 3rd-party support, accessories, power demands, and built-in features.

Decision Matrix

An initial discussion was held to determine the 1-10 weights that related to each category's perceived importance to the project. Given those weights, each team member created a table of scores that related a possible microcontroller choice to each category. The (1-10) weight is applied to the score and each member's scores are averaged and a TOTALS table is then populated with the averages. The total scores are then created for each microcontroller choice. Team member's overall microcontroller scores weren't used for the final tally, but it's interesting to note how each person ranked the four devices. The result of this process outputs a choice of ESP32 followed by ATMEGA32p, PI PICO, then FPGA.

TOTALS					
weight (1-10)					
		ESP32	ATMEGA 32p	PI PICO	FPGA
Familiarity	8	45	22	22	13
Cost	5	30	29	30	13
Ease of use	10	44	26	26	9
3rd-party Support	8	39	37	29	16
Accessories	4	36	33	32	12
Power Demands	1	25	29	24	13
Built-in Features	7	41	30	30	20
Score		1718	1248	1180	588

Nate					
weight (1-10)					
		ESP32	ATMEGA 32p	PI PICO	FPGA
Familiarity	8	9	9	5	2
Cost	5	9	8	4	1
Ease of use	10	9	9	7	2
3rd-party Support	8	7	10	5	5
Accessories	4	7	5	4	4
Power Demands	1	7	5	4	3
Built-in Features	7	9	7	4	4
Score		361	356	218	128

Mitch					
weight (1-10)					
		ESP32	ATMEGA 32p	PI PICO	FPGA
Familiarity	8	8	8	6	2
Cost	5	5	3	5	8
Ease of use	10	10	5	7	2
3rd-party Support	8	7	10	7	2
Accessories	4	8	10	7	2
Power Demands	1	1	1	1	2
Built-in Features	7	8	5	6	2
Score		334	285	270	116

Nitin					
weight (1-10)					
		ESP32	ATMEGA 32p	PI PICO	FPGA
Familiarity	8	10	1	1	3
Cost	5	6	6	4	1
Ease of use	10	7	4	2	1
3rd-party Support	8	8	6	5	4

Accessories	4	7	7	5	2
Power Demands	1	9	9	5	2
Built-in Features	7	9	7	5	4
Score		344	212	148	109

Sal					
weight (1-10)					
		ESP32	ATMEGA 32p	PI PICO	FPGA
Familiarity	8	10	1	5	3
Cost	5	5	5	9	2
Ease of use	10	10	3	5	2
3rd-party Support	8	9	5	5	2
Accessories	4	7	5	8	2
Power Demands	1	1	6	7	3
Built-in Features	7	7	5	8	6
Score		164	164	270	123

Annika					
weight (1-10)					
		ESP32	ATMEGA 32p	PI PICO	FPGA
Familiarity	8	8	3	5	3
Cost	5	5	7	8	1
Ease of use	10	8	5	5	2
3rd-party Support	8	8	6	7	3
Accessories	4	7	6	8	2
Power Demands	1	7	8	7	3
Built-in Features	7	8	6	7	4
Score		324	231	274	112

AHP

Below we have our normalized AHP matrix in yellow indicating which microprocessor we are electing to use, and below in green are the individual criteria matrices showing how we determined our scores. Based on our scores, it is clear that the microprocessor we have elected to use (ESP32) fits our decision and AHP matrices (in the below table, the lowest score is the winner). The lowest table breaks down how the individual criteria were used to calculate the weight by means of the geometric mean and the row means, with the result seen in the 'Weight' column above.

AHP Adjusted Matrix					
	Weight	ESP32	ATMEGA 32p	PI PICO	FPGA
Familiarity	0.06	0.04	0.14	0.09	0.73
Cost	0.24	0.08	0.04	0.17	0.71
Ease of use	0.07	0.11	0.05	0.11	0.74
3rd-party Support	0.09	0.22	0.03	0.11	0.64
Accessories	0.07	0.15	0.03	0.15	0.67
Power Demands	0.33	0.10	0.05	0.24	0.61
Built-in Features	0.13	0.12	0.63	0.23	0.03
Score		0.109	0.124	0.186	0.582

^ A Lower score is better.

Each cell reflects (column score/row score)

Familiarity	ESP32	ATMEGA 32P	PI PICO	FPGA	Geo mean	Normalized
ESP32	1.00	0.33	0.20	0.11	0.29	0.04
ATMEGA 32P	3.00	1.00	3.00	0.11	1.00	0.14
PI PICO	5.00	0.33	1.00	0.11	0.66	0.09
FPGA	9.00	9.00	9.00	1.00	5.20	0.73

^ How familiar is the team with a given choice

Cost	ESP32	ATMEGA 32P	PI PICO	FPGA	Geo mean	Normalized
ESP32	1.00	3.00	0.33	0.11	0.58	0.08
ATMEGA 32P	0.33	1.00	0.14	0.11	0.27	0.04
PI PICO	3.00	7.00	1.00	0.11	1.24	0.17
FPGA	9.00	9.00	9.00	1.00	5.20	0.71

^ Cost-effectiveness/Value for money of each microcontroller
As seen here, FPGAs are much more expensive than the other options.

Ease of Use	ESP32	ATMEGA 32P	PI PICO	FPGA	Geo mean	Normalized
ESP32	1.00	3.00	1.00	0.11	0.76	0.11
ATMEGA 32P	0.33	1.00	0.33	0.11	0.33	0.05
PI PICO	1.00	3.00	1.00	0.11	0.76	0.11
FPGA	9.00	9.00	9.00	1.00	5.20	0.74

^ Easy to get started with easily accessed tools.

3rd-party Support	ESP32	ATMEGA 32P	PI PICO	FPGA	Geo mean	Normalized
ESP32	1.00	9.00	3.00	0.20	1.52	0.22
ATMEGA 32P	0.11	1.00	0.11	0.11	0.19	0.03
PI PICO	0.33	9.00	1.00	0.11	0.76	0.11
FPGA	5.00	9.00	9.00	1.00	4.49	0.64

^ Good choice in vendors for hardware and software.

Accessories	ESP32	ATMEGA 32P	PI PICO	FPGA	Geo mean	Normalized
ESP32	1.00	7.00	1.00	0.14	1.00	0.15
ATMEGA 32P	0.14	1.00	0.14	0.11	0.22	0.03
PI PICO	1.00	7.00	1.00	0.14	1.00	0.15
FPGA	7.00	9.00	7.00	1.00	4.58	0.67

^ Availability of accessories (e.g. breakout boards, sensor modules, etc) for each product

Power Demands	ESP32	ATMEGA 32P	PI PICO	FPGA	Geo mean	Normalized
ESP32	1.00	3.00	0.33	0.14	0.61	0.10
ATMEGA 32P	0.33	1.00	0.20	0.11	0.29	0.05
PI PICO	3.00	5.00	1.00	0.33	1.50	0.24

FPGA	7.00	9.00	3.00	1.00	3.71	0.61

^ A brief period of research ranked choices in power usages, with lower scores reflecting high power usage.

Built-in Features	ESP32	ATMEGA 32P	PI PICO	FPGA	Geo mean	Normalized
ESP32	1.00	0.14	0.33	9.00	0.81	0.12
ATMEGA 32P	7.00	1.00	5.00	9.00	4.21	0.63
PI PICO	3.00	0.20	1.00	9.00	1.52	0.23
FPGA	0.11	0.11	0.11	1.00	0.19	0.03

^ What kind of features does each board come packaged with, such as WiFi, charging support, and antennas.

	miliar	Cost	Ease of use	3rd-party support	Accessories	Power demands	Built-in features	Mean	Geo Mean	Weight
Familiarity	1.00	1.00	1.00	0.20	1.00	0.11	1.00	0.76	0.58	0.06
Cost	1.00	1.00	9.00	7.00	5.00	0.14	7.00	4.31	2.27	0.24
Ease of use	1.00	9.00	1.00	0.20	1.00	0.11	0.33	1.81	0.68	0.07
3rd-party Support	5.00	0.14	5.00	1.00	1.00	0.11	1.00	1.89	0.88	0.09
Accessories	1.00	0.20	1.00	1.00	1.00	0.20	1.00	0.77	0.63	0.07
Power Demands	9.00	7.00	9.00	9.00	5.00	1.00	0.11	5.73	3.11	0.33
Built-in Features	1.00	0.14	3.00	1.00	1.00	9.09	1.00	2.32	1.21	0.13
										1.00

^ Decision factors are ranked against each other to derive weights.

Results:

As can be seen above in the two different matrices, the design matrix and AHP both agree that ESP32 best suits our needs for this project.