

2022 DAC System Design Contest

Jeff Goeders, Brigham Young University



https://byuccl.github.io/dac_sdc_2022/



Contest Organizers



Jeff Goeders



Callie Hao



Cheng Zhuo



Naveen Purushotham



With DAC 2021 only 7 months ago, this year was a fast schedule...

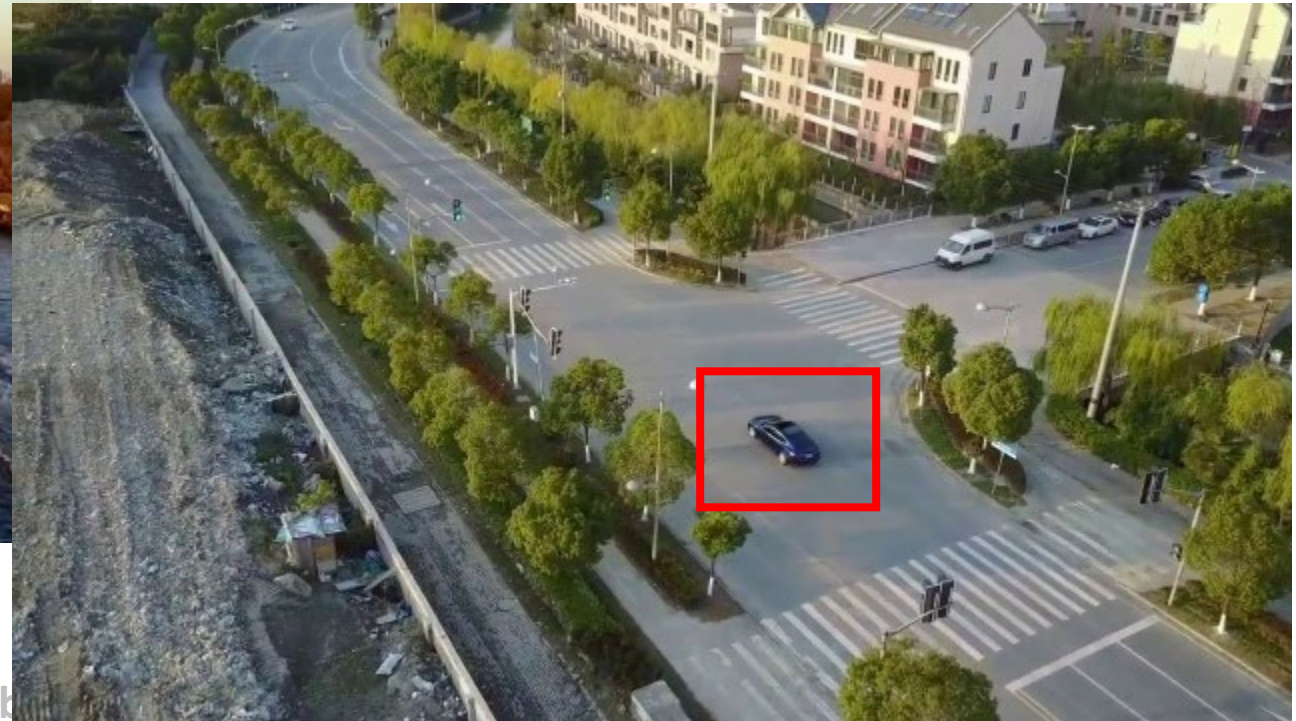
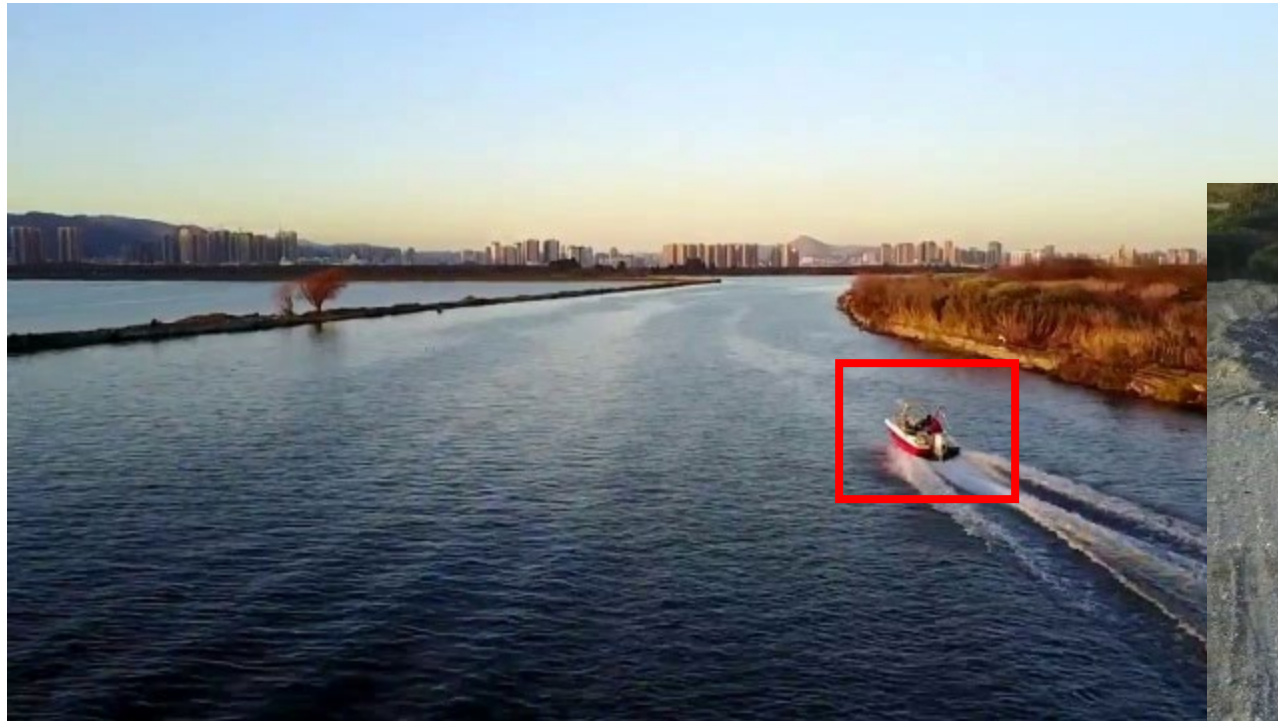
...but we still had a high level of participation.

73 teams registered from 40+ organizations



Contest Objective

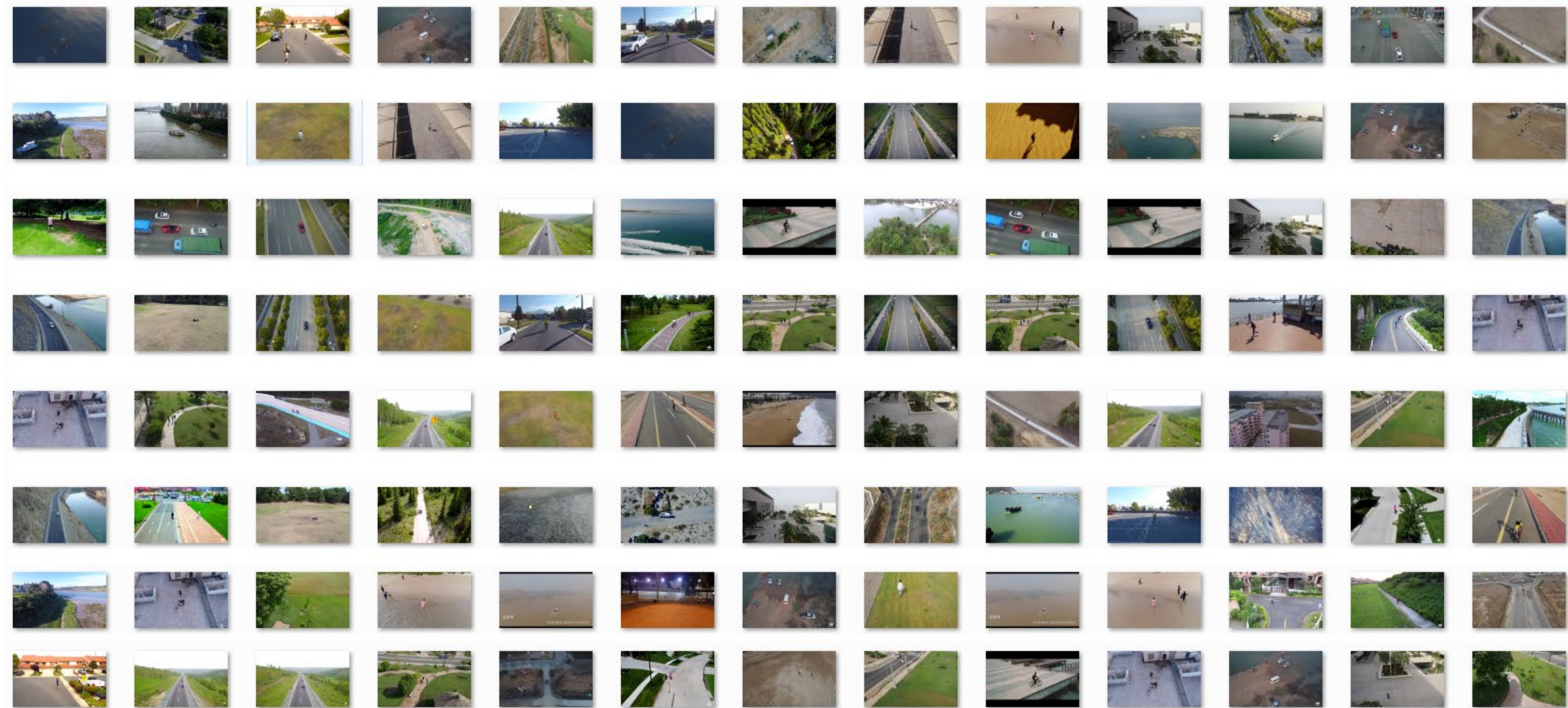
High-accuracy, low-power object detection on FPGA SoC device



Dataset

- Training and testing dataset from DJI
- 93,520 images for training
- 52,500 images for testing (not given to teams)
- Several different categories: boat, building, car, drone, group, horse ride, paraglider, person, riding, truck, wakeboard, whale, etc.
- Teams must detect one object in each image





https://byuccl.github.io/dac_sdc_2022/



Thank you!

A **big thank you** to our sponsor:

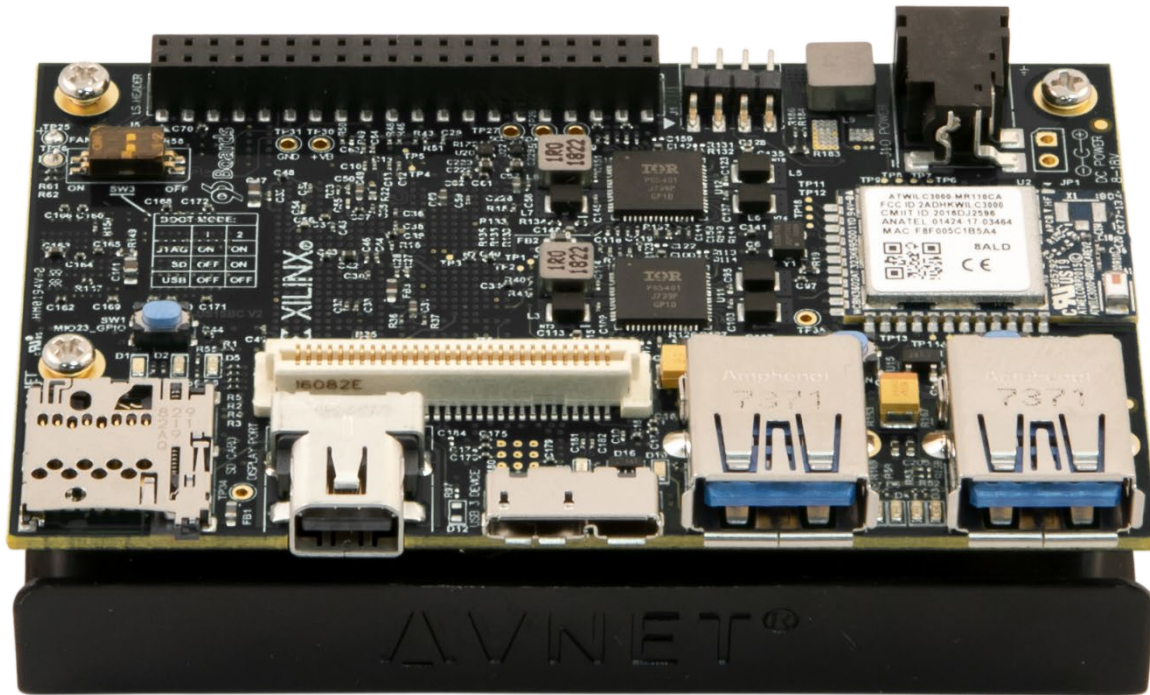
AMD 

XILINX

https://byuccl.github.io/dac_sdc_2022/



Platform



Ultra96 v2 Board

- Xilinx Zynq UltraScale+ MPSoC ZU3EG
- 4-core A53 ARM CPU
- 2 GB (512M x32) LPDDR4 Memory
- Running an Ubuntu Linux environment
- Contest framework in Python using the Xilinx PYNQ framework (<http://www.pynq.io/>)
- Teams are free to implement any part of the process in software or hardware

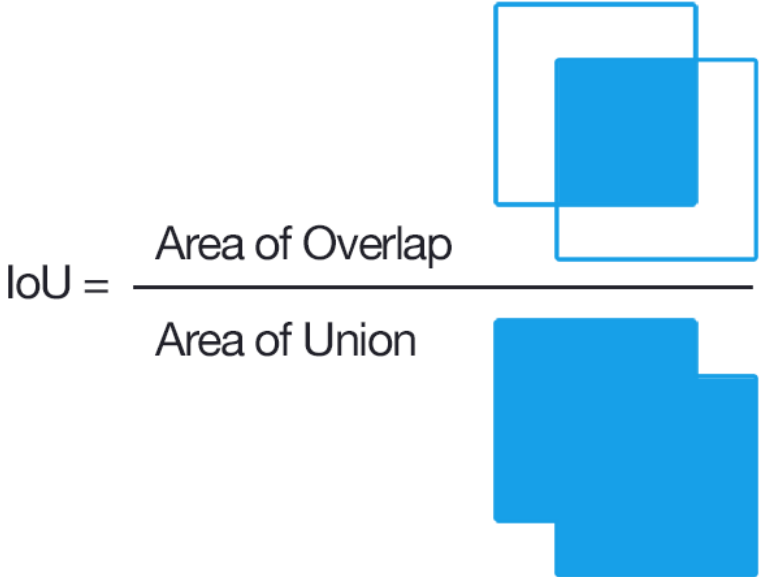


Evaluation

$$Score = Accuracy\ Score \cdot Energy\ Score \cdot FPS\ Penalty$$

Accuracy Score (0.1-1.0)

$$\max(\text{ReLU}(1 - 5 \cdot \text{ReLU}(0.7 - IoU)), 0.1)$$



Energy Score

$$\frac{100}{\log_2(\text{Total Energy Usage})}$$

- Power of Ultra96v2 board
- Polling on-board power regulators

FPS Penalty

$$\text{ReLU}\left(1 - \text{ReLU}\left(1 - \frac{FPS}{30}\right)\right)$$

Penalty if FPS is below 30



2020 Contest

Rank	Team Name	FPS	IoU
1.	BJUT_Runner	212.726	0.656
2.	ShanghaiTech_SkrSkr	52.429	0.731
3.	iSmart	50.682	0.724
4.	SJTU_microe	49.376	0.697
5.	XJTU_Tripler	42.507	0.744
6.	SEUer	36.530	0.722
7.	neverwin	22.008	0.695

2021 Contest

Rank	Team Name	FPS	IoU
1	SkrSkr	299.250	0.716
2	iSmart	285.750	0.708
3	SJTU_microe	249.380	0.703
4	good_study	239.610	0.703
5	CSU-Dragonfly	245.700	0.708
6	SEUer	181.150	0.723
7	III CORPS★	149.930	0.696

Issue: Reading images from SD card limits solutions to ~300fps.

- 2021 teams fully parallelized image reading with processing, but image reading became the bottleneck

https://byuccl.github.io/dac_sdc_2022/



Changes in 2022

- Same platform, test images, and goal.
- FPS Metric:
 - Reading from SD card no longer part of runtime
 - Teams are provided images in 1000 image batches
- Energy
 - Previous years: Entire board power
 - This year: Power reported by only relevant regulator channels
 - (ignores I/O pins, display port, etc.)



2022 Awards

- Teams recognized at tomorrow's DAC awards ceremony
- Cash prize:
 - 1st place: \$1500
 - 2nd place: \$1000
 - 3rd place: \$500



RANK	TEAM NAME	FPS	IOU	FPS PENALTY	IOU PENALTY	ENERGY(J)	ENERGY SCORE	TOTAL SCORE
**	InvolutionNet							
**	SEUer							
**	ultrateam							
4	UBPercept	593.530	0.704	1.00	1.00	202.1	7.659	13.057
5	404NotFound	492.560	0.699	1.00	1.00	259.3	8.018	12.409
6	super-capacitor	386.150	0.708	1.00	1.00	289.6	8.178	12.228
7	Monday*	379.840	0.703	1.00	1.00	291.8	8.189	12.212
8	BoatingWithoutPaddle	293.670	0.699	1.00	1.00	309.0	8.271	12.029
9	TmpSEU*	363.910	0.702	1.00	1.00	354.1	8.468	11.809
10	SoutheastASIC	401.520	0.703	1.00	1.00	355.6	8.474	11.801
11	GoLukeGo	298.650	0.700	1.00	1.00	400.4	8.645	11.567
12	seuplayers	404.770	0.688	1.00	0.94	327.8	8.357	11.248
13	TouchFish	349.040	0.709	1.00	1.00	612.6	9.259	10.801
14	txh	351.170	0.709	1.00	1.00	629.6	9.298	10.755
15	CCAI_ZJU	250.920	0.695	1.00	0.98	586.7	9.196	10.602
16	whatever*	153.950	0.680	1.00	0.90	883.5	9.787	9.196
17	BIT_gd	56.020	0.725	1.00	1.00	3,143.7	11.618	8.607
18	gd_BIT	54.510	0.725	1.00	1.00	3,566.6	11.800	8.474
19	Vienna EML	528.530	0.620	1.00	0.60	312.7	8.289	7.239
20	YoLook	507.910	0.593	1.00	0.47	260.8	8.027	5.793
21	LU_CORPS	283.480	0.596	1.00	0.48	540.7	9.079	5.287
22	dpu_b2304_yolox_pybind	136.190	0.597	1.00	0.49	976.3	9.931	4.884
23	MTC	534.920	0.568	1.00	0.34	249.5	7.963	4.270
24	YJY*	14.500	0.737	0.48	1.00	8,587.0	13.068	3.699
25	ShinyRosy*	7.340	0.714	0.24	1.00	26,144.5	14.674	1.667
26	sephjiang*	7.340	0.714	0.24	1.00	26,764.1	14.708	1.663



Announcing the Winners!

- 1. SEUer** Southeast University
- 2. UltraTeam** Southeast University
- 3. InvolutionNet** Institute of Computing Tech., Chinese Academy of Sciences



RANK	TEAM NAME	FPS	IOU	FPS PENALTY	IOU PENALTY	ENERGY(J)	ENERGY SCORE	TOTAL SCORE
1	SEUer	2,020.6	0.703	1.00	1.00	36.7	5.198	19.239
2	ultrateam	2,266.2	0.703	1.00	1.00	40.3	5.333	18.752
3	InvolutionNet	712.8	0.708	1.00	1.00	144.6	7.176	13.935
4	UBPercept	593.5	0.704	1.00	1.00	202.1	7.659	13.057
5	404NotFound	492.6	0.699	1.00	1.00	259.3	8.018	12.409
6	super-capacitor	386.2	0.708	1.00	1.00	289.6	8.178	12.228
7	Monday*	379.8	0.703	1.00	1.00	291.8	8.189	12.212
8	BoatingWithoutPaddle	293.7	0.699	1.00	1.00	309.0	8.271	12.029
9	TmpSEU*	363.9	0.702	1.00	1.00	354.1	8.468	11.809
10	SoutheastASIC	401.5	0.703	1.00	1.00	355.6	8.474	11.801



The Top 3 Rankings

2022

Team Name	IoU	Power (mW)	FPS	Total Score
SEUer	0.703	1413	2020.56	19.24
UltraTeam	0.703	1740	2266.16	18.75
InvolutionNet	0.708	1963	712.75	13.94

2021

Team Name	IoU	Board Power (mW)	FPS	Total Score
SkrSkr	0.716	3768	299.25	10.66
iSmart	0.708	4638	285.75	10.27
SJTU_microe	0.703	4951	249.38	9.97

2020

Team Name	IoU	Board Power (mW)	FPS
BJUT_Runner	0.656	6650	212.73
SkrSkr	0.731	6755	52.43
iSmart	0.724	7358	50.68

2019

Team Name	IoU	Board Power (mW)	FPS
iSmart3	0.716	7260	25.05
XJTU_Tripler	0.615	9248	50.91
SystemsETHZ	0.553	6685	55.13

https://byuccl.github.io/dac_sdc_2022/



Presentations from the Winning Teams

https://byuccl.github.io/dac_sdc_2022/



3rd Place

Team InvolutionNet

Haitong Huang

Erjing Luo

Cangyuan Li

*Center for Intelligent Computing Systems, Institute of Computing
Technology, Chinese Academy of Sciences*

https://byuccl.github.io/dac_sdc_2022/



2nd Place

Team UltraTeam

Meng Zhang

Harvey Zhang

Shuqi Wang

Southeast University

https://byuccl.github.io/dac_sdc_2022/



1st Place

Team SEUer

Jingwei Zhang

Xinye Cao

Yu Zhang

Guoqing Li

Southeast University

https://byuccl.github.io/dac_sdc_2022/



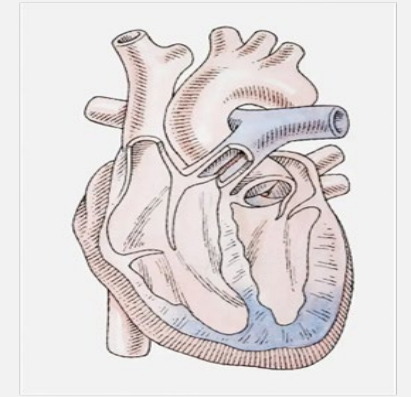
Wrap-up

- Top 3 designs will be made available on Github. Follow contest website for updates.
- If you have questions, please email me, Jeff Goeders jgoeders@byu.edu
- Thanks to all the teams that participated!





2022 ACM/IEEE TINYML DESIGN CONTEST AT ICCAD



Problem

Machine learning based ventricular arrhythmias detection on ultra low-power MCUs for Implantable Cardioverter Defibrillators

Awards

1st Place: \$4,000
2nd Place: \$1,500
3rd Place: \$500

Tentative Schedule

Contest release date Jul 15, 2022
Registration deadline Jul 30, 2022
Final submission due Sep 30, 2022

See website for details or to register

<https://tinymlcontest.github.io/TinyML-Design-Contest/>

Winners will be announced at ICCAD 2022



South-Central Minzu University



University of Notre Dame



SINGULAR MEDICAL