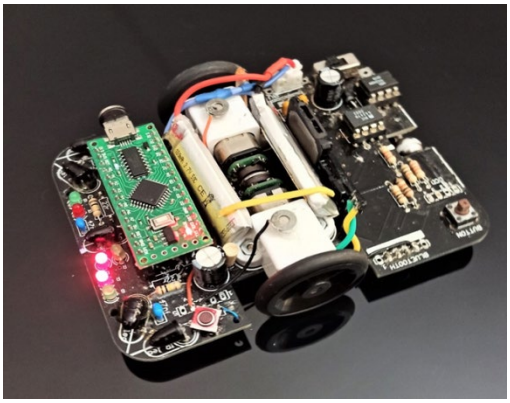
APEC 35th Annual Micromouse Contest

The goal of the contest is to design and build a robot that can navigate from the corner of a 10-foot square maze to the center in the shortest time. For most entrants the contest is divided into two phases, the search phase and the run phase. During the search phase the mouse determines at least one path from the start to the center and may seek additional paths in hopes of finding a faster one. During the run phase the mouse goes as quickly as possible from the start square in the corner of the maze to the center of the maze along the previously determined optimal path. Scoring is based on 1/30th of the time used to search the maze prior to the start of each run *(maze time),* and the time of that run *(run time).* If the mouse has crashed or been manually restarted *(touched*) prior to the start of a run, a penalty of 2 seconds is added to the score.

List of Contestants for APEC 2024 Micromouse Contest

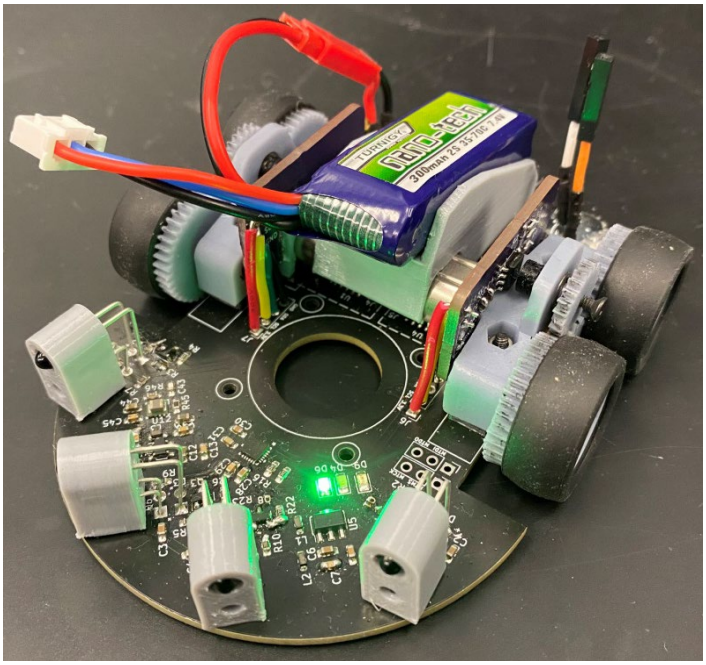
Mouse Name	Handler	Affiliation	Country
HAL900	Jim Chidley		UK
Mercury	Kyle Tyni	UC Irvine	USA
Pi:Co Classic 3	Yuki Nakagawa	RT Corporation	Japan
uMouse	Pratham Desai, Robert Kuramshin		USA
Mazerunner 32	Peter Harrison		UK
Major 1	Brian Johnson		USA
MovEye	Yuta Takemoto	Mitsubishi Electric	Japan
Gus	Nathan Nguyerndinh	UCLA	UHSA
Zeetah VII	Harjit Singh		USA
Bigger Chunky	Parth Pandhare	UCLA	USA
Mr. Fusion	Derek Hall		UK
Que	Yuta Takemoto		Japan
Decimus 5A	Peter Harrison		UK
Thunder	Takeru Kimura	Waseda University	Japan

HAL900 Was designed and built by Jim Chidley and Derek Hall and originally intended in 2017 as an easy to assemble full maze-solving Micromouse kit. HAL900 is assembled with through-hole components; An Arduino Nano, 5 IR LEDs and 3 receivers to detect the walls, 2 magnetic encoders recording 1 count per mm and a DFPlayer PRO mp3 module to allow HAL to talk.



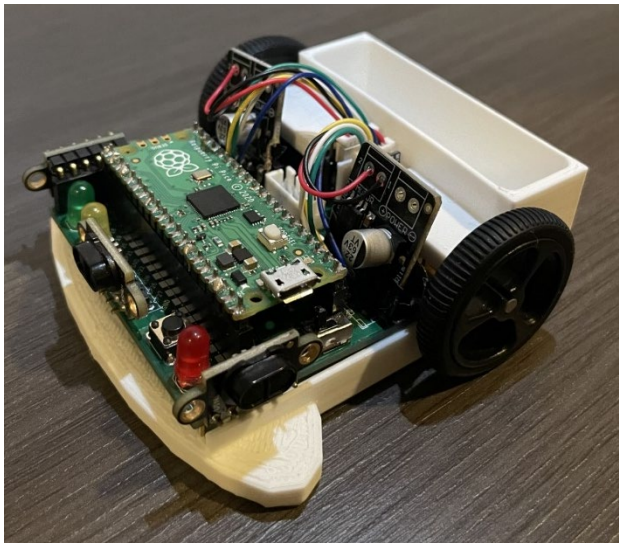
Lenght- 100mm
Width- 75mm
Weight- 101g
Batteries- 2x 180mah
Motors- N20 10:1

Mercury was designed and built by Kyle HenrikTyni, a student at UC Irvine. It utilizes a dual core ESP32-S3 processor running FreeRTOS. One core is used for sensor processing and the other for the control algorithms**.** Sensors include 4 IR emitter-receiver pairs, a gyro, and magnetic encoders.

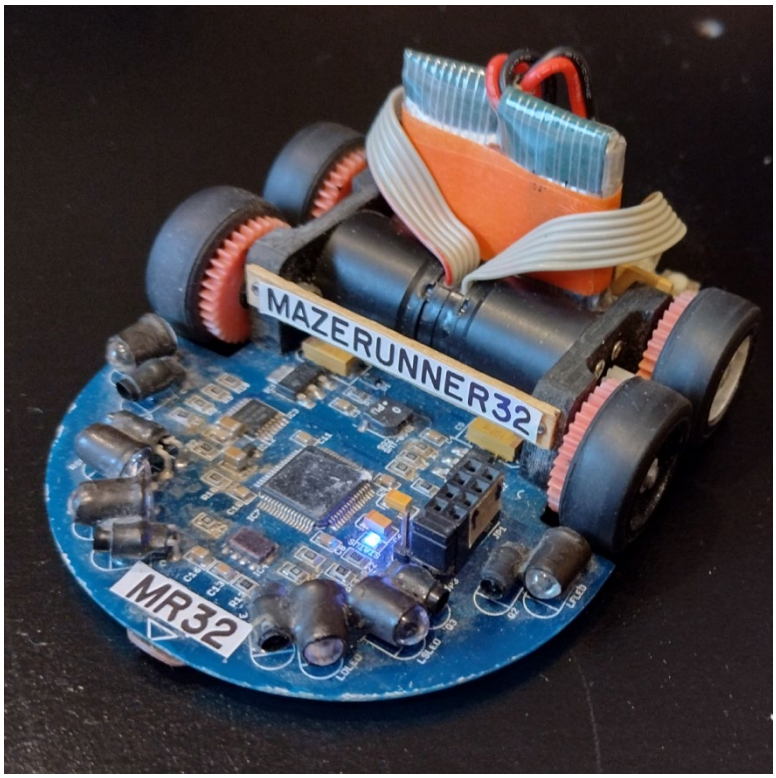


Pi:Co Classic3 is designed and produced by the RT Corporation out of Japan. Yuki Nakagawa is the founder and president of the company. This micromouse kit is often used by students getting their first start in micromouse. Yuki is also involved with the New Technology Foundation, a non-profit that promotes micromouse in Japan. Any foreigners who participate in the All Japan Contest can be asured of a warm welcome and ready smile from Yuki.

uMouse was designed and built by Pratham Desai and Robert Kuramshin, software engineers in the Bay Area. They saw the Veritasium video last summer (part of which was filmed at APEC 2023) and decided they were very interested in competing themselves. Here they are today!



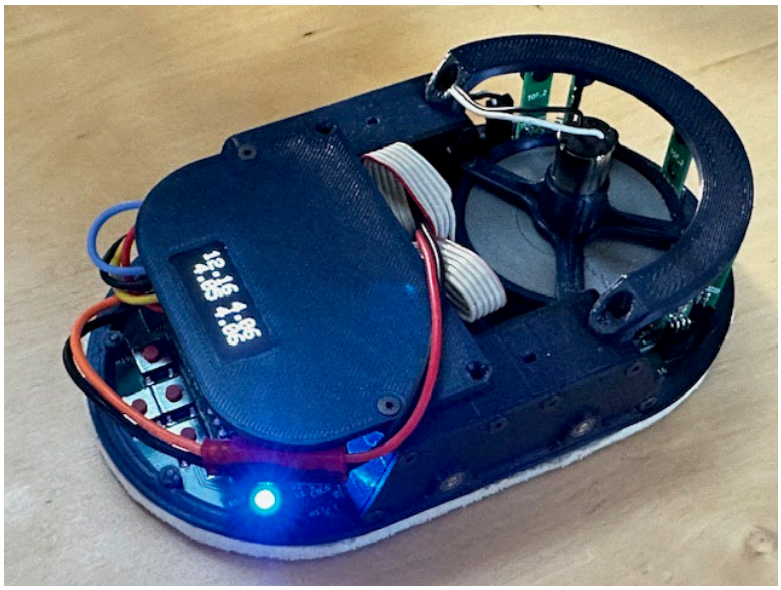
Mazerunner32 (MR32) is a classic (full size) micromouse by Peter Harrison from the UK. The robot is now a development mule for new software. Originally run as Decimus 4, the robot uses the common four-wheel drive layout and 6 Volt motors to give a top speed in excess of 5m/s and just under 1.5g forward and 2g lateral acceleration. In its original form, it placed third at APEC in 2017.



The ARM cortex M4 processor is an STM32F405 with 1Mbyte of flash and 192kbyte RAM. Running at 144MHz, it performs all the navigation, solver and control functions using floating point throughout.

The software development is being undertaken for a new version of the UK Micromouse and Robotics Society (UKMARS) reference design for a micromouse. The existing UKMARSBOT design is intended to be a basic, inexpensive introduction to micromouse, and robotics in general, using an Arduino Nano paired with very cheap motors. While it performs well enough for all that, we felt it worth providing a template for a more advanced, competitive micromouse robot. The new software is a development of the mazerunner software provided with UKMARSBOT. Extended to make full use of the facilities available of a 32 bit processor. Having a known-good hardware base for new software greatly eases the task. Once tested and proven, it will be made available to all.

Major 1 is named after my dad who passed away in 2022 but helped me build a test maze for the original contest back in 1979 when he was 53 and I was 26. His name was Major Alan Johnson and often abbreviated his name Major to his initials, MAJ.



My original design for 1979 had a similar shape and size as this one but only had 2 wheels instead of 4. I'm also using the same cell to cell paths that I designed back then. I'm glad to say that today I don't have to worry too much about memory or speed. In 1979 I was using an 8 bit Intel 8085 running at 3 MHz with external memory. Now I'm using a 32 bit ARM Cortex-M7 running at 600 MHz with the memory integrated. It's nice to see what 45 years of improvement can do.

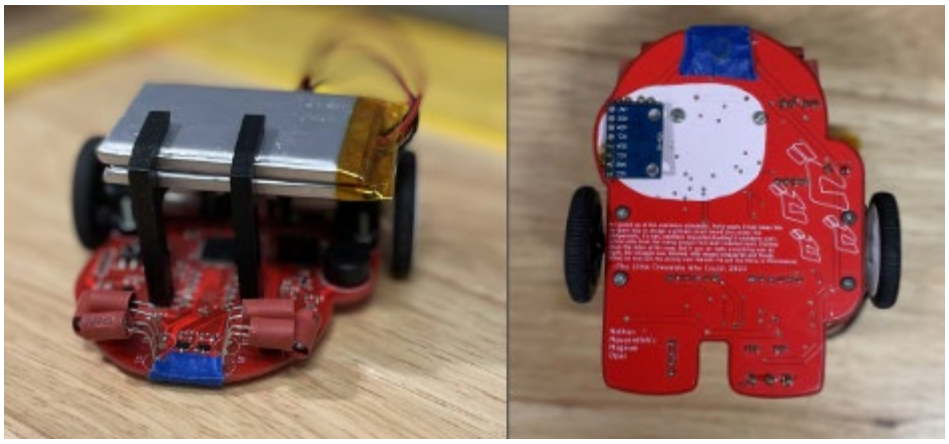
Name	MAJ
Designer	Brian Johnson
Dimensions	130x80x36 mm
Weight	?
Drive Motor	1717T006SRIE2-1024 (x2)
Vacuum Motor	3.7V 10x20mm Coreless

Motor Drivers	TI DRV8256P (x3)
Tires	23x9 mm (x4)
Gear Ratio	40:12 m0.5
CPU	IMXRT1062DVL6: 600MHz, 2MB Flash, 1MB RAM
IMU	LSM6DSO, LIS3MDL, LPS22DF
Battery	11.1V, 300mAh LiPo
Optics	ST VL531L ToF (x5)
Max Speed	?
Max Acceleration	?
Turn Speed	?
User Interface	4 Pushbutton, 2 RGB LEDs, OLED display (128x32)

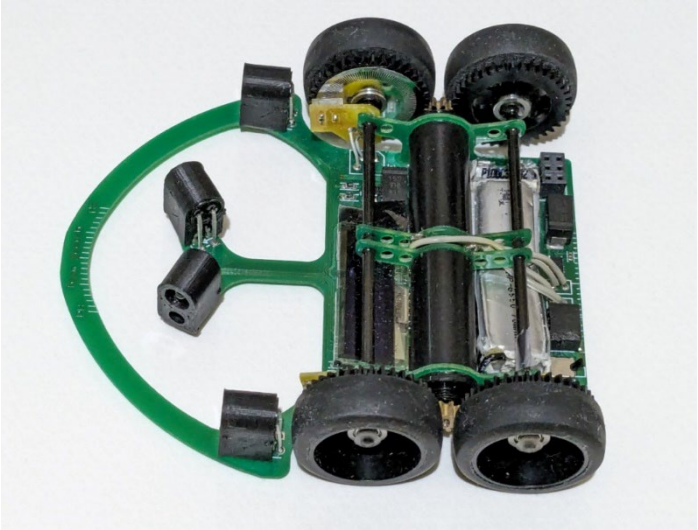
MovEye was developed by Mitsubishi Electric. Mitsubishi Electric is aiming for open innovation by establishing a new robot competition as a place to promote technology to realize a society where humans and robot coexist. We plan to demonstrate the new ball-throwing competition in 2025. This micromouse was created for the new competition, but can also run existing competitions.

CPU: RX66N
Sensor: Multi-zone ToF(8*8) *2, IR-Sensor, Gyro, Rotary encoder
Touch display
Weight: 250g

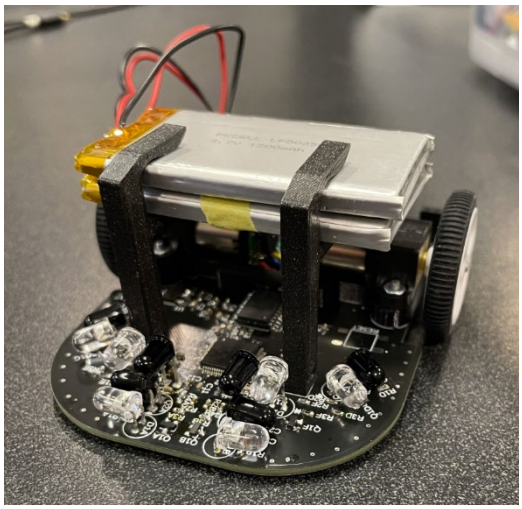
Gus was designed by Nathan Nguyendinh as part of the beginner Micromouse program of IEEE at UCLA. Nathan led the program last year with the goal of teaching underclassmen students the basics of PCB design and embedded systems. To encourage fun and creativity in the program, the board for Gus is modeled after a character from the hit game, “Among Us”. Gus won 1st place at the University-level All America Micromouse Competition held by IEEE at UCLA in 2023, and he’s ready to see the big leagues!



Zeetah VII was designed and built by Pierre Hollis and Harjit Singh. The idea behind this mouse was to see how light we can make it. The mouse weighs in at 44 g. It uses an STM32F411 CPU which runs at 100MHz, has 512kB flash, and 128kB of RAM. The mouse has 16MB of flash for logging, AD22425 analog gyro along with a BMX055 accelerometer/gyro (to compare the gyros), a 128x32 OLED display and 512 count encoders on the wheel. Power comes from two LiPo 70 mAh cells. The motors are MicroMo 1024S. The mouse measures 84mm x 74mm.

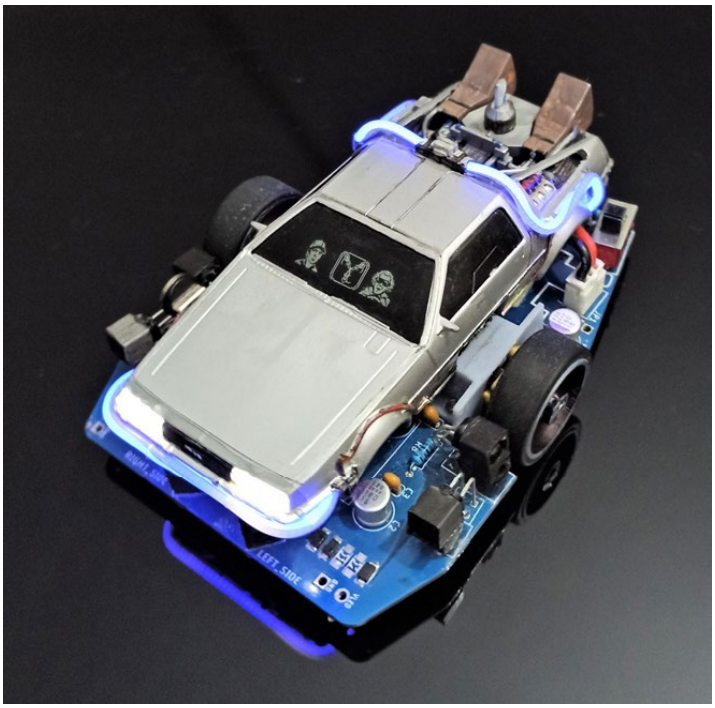


Bigger Chunky was designed and programmed by Parth Pandhare & Matthew Chandler as a part of IEEE at UCLA's micromouse program. The mouse is named affectionately after a carton of soy milk that was left in our room over winter break 2022-23. I know, a weird origin story, but we thought it was funny at the time, and the name just stuck. Bigger Chunky hopes to perform well at APEC this year.



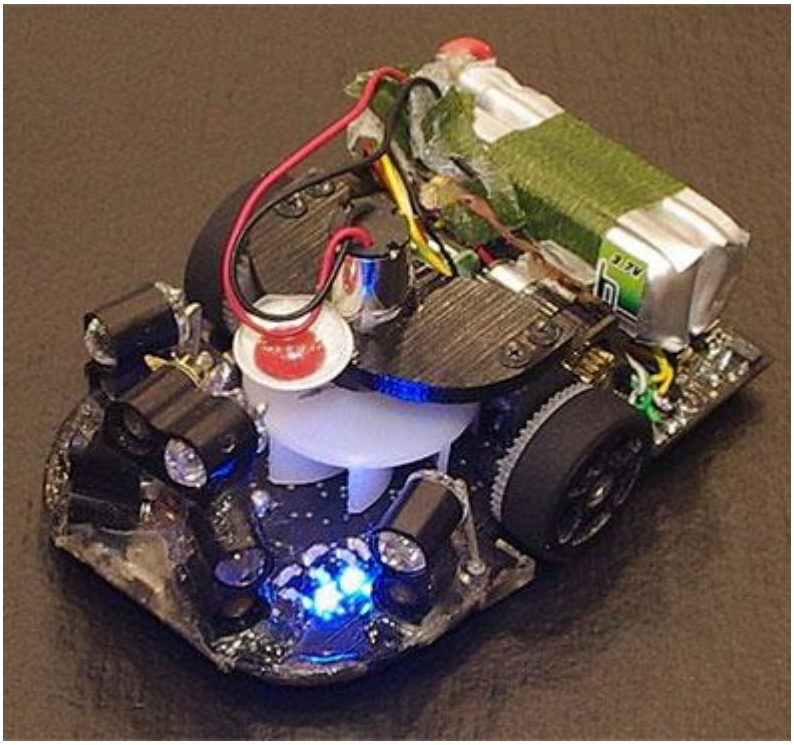
Mr Fusion Was designed and built by Derek Hall and Jim Chidley. It has 6 IR LEDs paired with 6 receivers detecting the walls, while the AMS magnetic encoders record 875 counts per mm. The main processor is an Arduino 33 Nano BLE with DeLorean light effects and an animated screen controlled by a separate Pi Tiny 2040. The software is a modified version of this open-source Micromouse software https://github.com/ukmars/mazerunner-core.

Length- 105mm
Width- 76mm
Weight- 104g
Batteries- 2 x 180mah
Motors- N20 5:1

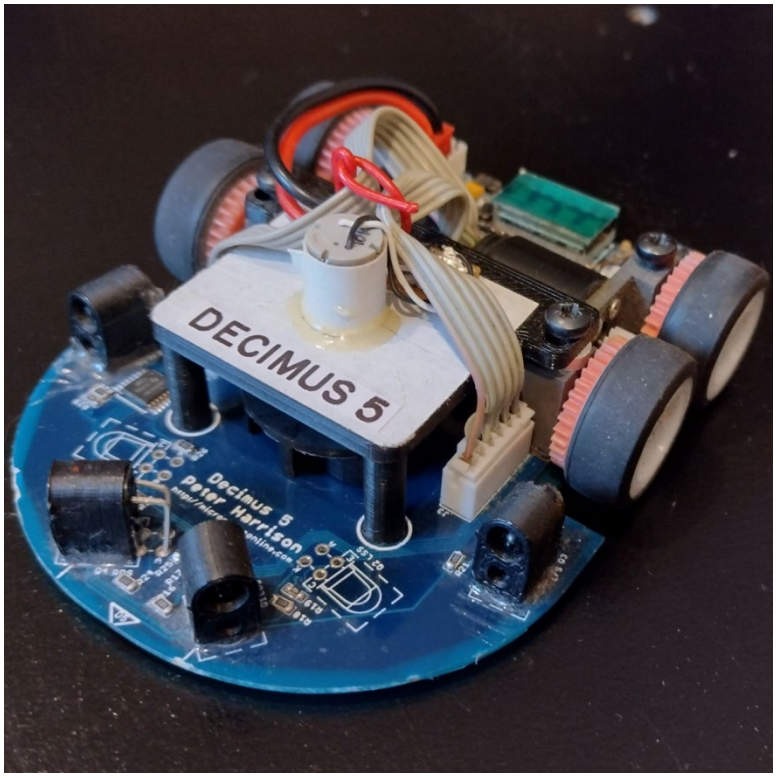


Que was desighd and build by Yuta Takemoto. This is a small micromouse, about half the size of a normal micromouse. In addition, it has a suction mechanism. This robot took second place in the 2015 All-Japan Micromouse Competition. Que came in 9th in the half size category and 54th in the full size or classic category at the 44th All Japan Contest held in Toyko last weekend.

CPU:RX62T
Sensor: IR Sensor x 5, Gyro(ADXRS610) , Rotary Encoder(MES-6)
Weight: 35g



Decimus 5A is a classic (full size) micromouse by Peter Harrison from the UK. This robot is a direct descendant of Decimus 4 and uses the same four-wheel drive layout. This model, however sports a fan which creates a low pressure area under the mouse to provide additional downforce equivalent to more than twice the weight of the mouse and corresponding increased grip. In addition, the motors are nominal 3Volt units, still driven by a 7.4V LiPo battery



That amount of additional grip gives a significant increase in performance. Cornering can be 50% faster with centripetal accelerations approaching those found in F1 racing cars. Nearly 6g has been achieved in testing. In a straight line, Decimus 5A could out accelerate a Tesla Roadster - until Elon Musk strapped one into a rocket.

Faster runs requires stronger parts in case of accident and new magnesium alloy motor mounts and heavy duty Delrin wheels help to ensure survivability. No crumple zones here.

The ARM cortex M4 processor is an STM32F405 with 1Mbyte of flash and 192kbyte RAM. Running at 144MHz, it performs all the navigation, solver and control functions using floating point throughout while still only taking up less than 10% of the available processor power.

Improvements to the searching and pathfinder algorithms attempt to find the most effective route by taking into account the mouse dynamics and the need to search as fast as possible. New turning and navigation algorithms have contributed to better stability through the run.

Thunder was designed and built by Takeru Kimura, at student at Waseda University. It is characterized by its lightweight design, weighing only 20 grams. It utilizes small-sized batteries and motors. Additionally, it has have custom-built encoders to reduce weight. It estimates the speed by detecting slits in the gear. While control may not be easy, it is capable of achieving high speeds. Thunder came in 6th out of 60 entries that finished at the recent All Japan Contest in Toyko. Its sibling Lightning came in 4th in the half size version of the same competition.

Technical Information

Robot name	Thunder
Dimensions (Length, Width, Height)	90 mm, 72 mm, 25 mm
Weight	20.3 g
Motors (Drive)	CL-0614-10520-7
Motor (Fan)	Mk07-3.3
Tire size (Diameter, Width)	13 mm, 3.5 mm
Gear ratio	38:9
MCU	STM32F411CEU (100MHz)
ROM/RAM	-
Wall Sensors	SFH4550 (Emitter) + ST-1KL3A (Sensor)
Gyro	ISM330DHCX
Encoders	GP2S60
Motor Drivers	DRV8835DSSR
Battery	Lipo 70mAh 2S
Speed (Top, Acceleration, Turn)	5 m/s, 25 m/ss, 2.4 m/s
User Interface	Push Button * 1 + LED * 4