APEC 30th 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 not crashed or been manually restarted prior to the start of a run, a bonus of 2 seconds is subtracted from the score.

List of Contestants for APEC '16 Micromouse Contest

Mouse Name	Affiliation	Country
Zeetah VI	Harjit Singh, Pierre Hollis	United States
Hippo C	Lunghwa University of Science and Technology	Taiwan
PicOne Turbo	Derek Hall, Jim Chidley	UK
Long V2.0	Tianjin University	China
Anonomouse	University of Texas El Paso	United States
Elf Mouse	Nankai University	China
Fab 1	Derek Hall, Jim Chidley	UK
Lightning McQueen V4.0	Tianjin University	China
Green Giant 5.16V	Cal State, Los Angeles	United States
Excel-9	Khiew Tzong Yong	Singapore
Decimus 4E	Peter Harrison	UK
Que	Yuta Takemoto	Japan
Diu-Gow 4	Lunghwa University of Science and Technology	Taiwan

Zeetah VI was designed and built by Pierre Hollis and Harjit Singh. Zeetah VI implements a four wheel drive system. The mouse uses the STM32F103 microcontroller. Power comes from two LiPo 100 mAh cells. The motors are MicroMo 1717T003SR with IE-512 encoders. The mouse measures 92 mm x 74 mm and weighs 82 g.

Diu-Gow 4 was designed and built by Xin-Han Cai in 2015. He is currently an undergraduate student in Lunghwa University of Science and Technology, and is going to pursue his master degree this year in the same school. Diu-Gow 4 is equipped with a 3D printed vacuum fan to prevent skidding in high-speed turns. Because of the vacuum fan, Diu-Gow 4 turns about 25 percent faster than its older brother Diu-Gow. Diu-Gow 4 won first place in the All Japan Micromouse contest in 2015. Chao-Wei Chen is a partner of Xin-Han Cai Cai. The technical information for this mouse is in a table on the next page.

Hippo C was designed and built by Huan-Jie Liao in 2016. He is currently a master student in Lunghwa University of Science and Technology. Hippo C is also equipped with a vacuum fan to increase friction while turning. The fan and fan body were made with a CNC machine. A boost switching power circuit is used to provide a stable voltage input for the DC motors, though its reliability is still under test.

The team hopes that it will be finished in time for the contest. The older brother, Hippo, was rated the 7th in the All Japan micromouse contest in 2015. Yu-Chih Lin is a partner of Huan-Jie Liao.

Both Taiwan entries are from the Embedded Control System Laboratory of the Department of Electronic Engineering at Lunghwa University of Science of Technology, which is organized and led by Professor Juing-Huei Su.

PicOne Turbo is a modified PicOne Micromouse Kit. Their original concept was to promote awareness for Micromouse throughout schools and colleges with a simple to build low cost kit. It uses a Pickaxe 28x2 with 512 bytes of RAM. This is a Microchip 18 series PIC with a built in basic interpreter. It is driven by two low cost 6v motors and has three TSL262R sensors to detect the walls. It is programmed in Basic and runs without any interrupts.

Lightning McQueen V4.0 and **Long V2.0** are designed and built by students at Tianjin University in China. The technical information for these mice is in a table on the next page.

Anonomouse is designed and built by students from the University of Texas in El Paso.

Elf Mouse is designed and built by students from Nankai University in China.

FAB 1 parodies the Thunderbird's pink Rolls Royce. It uses a STM32 processor running at 72 MHZ with 96k of RAM. It has 6 TSL262R sensors and 100mAh LiPo batteries. The total weight of 100g is driven by six powered wheels, allowing the mouse to accelerate and decelerate at much higher speeds. The two centre wheels are mounted 0.5mm lower than the others, allowing uncompromised high speed cornering. It measures 115mm(L) x 75mm(W) x 22mm(H).

Green Giant 5.16V (vacuum design) is designed and built by Luzhou Ye (Green Ye) a student at Cal State LA. The technical information is in a table on the next page.

Excel-9 is designed and built by Mr Khiew Tzong Yong from Singapore. This robot design is one of a kind with 8-wheels driven by 4 DC-motors. For more info, visit http://bit.do/APEC-EXCEL-9.

Decimus 4E is a classic (full size) micromouse by Peter Harrison from the UK. Using the common four-wheel drive layout, this revision has a top speed in excess of 5m/s. The use of 3D printed parts has greatly simplified the mechanical design and construction of this mouse. Sensor alignment in particular is much easier with IR absorbing, 3D printed mounts. Decimus 4E has demonstrated repeatable turns at nearly 2g of centripetal acceleration and straight-line accelerations of up to 15m/s. The ARM cortex M4 processor is an STM32F407 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.

Que is designed and built by Yuta Takemotor from Japan. It is a half size mouse with a length of 61 mm, width of 42.5 mm and height of 28 mm. In Japan and Taiwan they have a contest where the normal size of the maze is divided into a 32 x 32 cell grid and each cell is only 9 cm x 9 cm. Que can run in both the full size maze (called classic in Japan) and half size. The weight of the mouse is 36 grams but it has a vacuum fan that can produce 50 g of thrust. The maximum speed is 3.9 m/s and it can take a 90 degree turn at 2 m/s. It uses a Renesas RX62T CPU running at 96 MHz. The processor has a very important FPU. The power comes from two 160 mAH Lipo cells   One problem with a half size mouse is that the small wheels pick up dust during the search run, making it difficult to make a speed run without first cleaning the tires. In the 2015 Eastern Japan Micromouse Contest, Que came in first in both the classic and half size category. The character of the mouse is embodied in its red eye.

The maze design for this year's contest was prepared by Mr. Gerado Molina. He has designed the mazes for all the recent APEC contests. He has a "Maze Solver" app on the App Store if you are interested.

Technical information for the Tianjin University entries.

Name	Lightning McQueen V4.0	Long V2.0
Designer	Zhangqi Kang, Xiaoyu Wang, Le Xue	Le Xue
Processor	STM32F103RBT6	
Motor	FAULHABBER 1717-006SR * 2	
Encoder	IE2 1024 * 2	IE2 512 * 2
Gear Ratio	10:40	
Motor Driver	MAX4427CSA + ZXMHC3F381N8 * 2	
Infrared emitter	SFH4550 * 4	SFH4550 * 6
Infrared sensor	TPS601A * 4	TPS601A * 6
Gyroscope	ADXRS620	
User interface	Button + 8* LED	

Technical information for the Lunghwa University of Science and Technology entires.

	Diu-Gow 4	HIPPO C
Length/Width	105mm/79mm	99.6mm/79mm
Height/Weight	40 mm/ 100g	31.14 mm/ 110g
Drive Motor	1717T006SR + IE2-512 x 2 Vacuum motor : Maxon RE8 x 1	
Tire size	Diameter : 21.5mm, Width : 9mm	
Gear ratio	60:16	
CPU	Renesas RX62T	
Flash ROM	32KB	
On chip RAM	16KB	
Wall Sensor	OSRAM SFH4550 x 6 TOSHIBA TPS601A x 6	
Gyro	ADXRS620 STM LY3100ALH	ADXRS620
Top/turn speed	4.1m/s, 120~200cm/s	3.8m/s, 120~180cm/s
Display	RGB x 2	
Power Source	Lithium Polymer 120mAh2S(7.4V)	

Technical information for the Green Ye entry.

Name: Green Giant 5.16V	Designer: Luzhou Ye (Green Ye)
Dimension:H:35.2mm W:75mm L:100mm	Weight 110g / Nominal suction force:98.9g/W
Gear Ratio 60:16 M0.3 / wheel D:22mm W:9mm	Battery: 180mah 45C LiPo 3S1P (11.1V)
MCU: STM32F405RG at 168MHz with 8MHz OSC	Memory: MCU built-in 192KB ram and 1MB ROM
IR Sensor: SFH4550 X 4 + TEFT4300 X 6	MEMS: MPU-6500 X 1 @ 20M Rate for SPI
Motor: 1717T006SR with IE2-512 X 2	Fan Motor: CL-0820-17 X 1
Internal Power Regulation: LMZ21701(5V) + LMZ10501(3.3V) + LMZ10501(2V) + TLV713P (A3.3V)	
UI: HCMS-2903 LED display X 1 + LED x 9 + Button X 2 + Buzzer X 1	
Fan Power Supply: buck converter to 3.1V, 3A max (TPS62130)	
Motor Power Supply: boost converter to 13V, 7.8A Max (TPS43061)	
Motor Driver: UCC27524 (Driver) X 2 + DMHC3025LSDQ-13 (H-Bridge) X 2	
Fan Driver: UCC27524 (Driver) X 1 + RF4E070GN (Low Side N-Mosfet Drive) X 2	

Max Speed: 5m/s	Max Acceleration: 17m/s/s	Max Turn Speed: 1.3m/s(90v) 1.6m/s(90L)