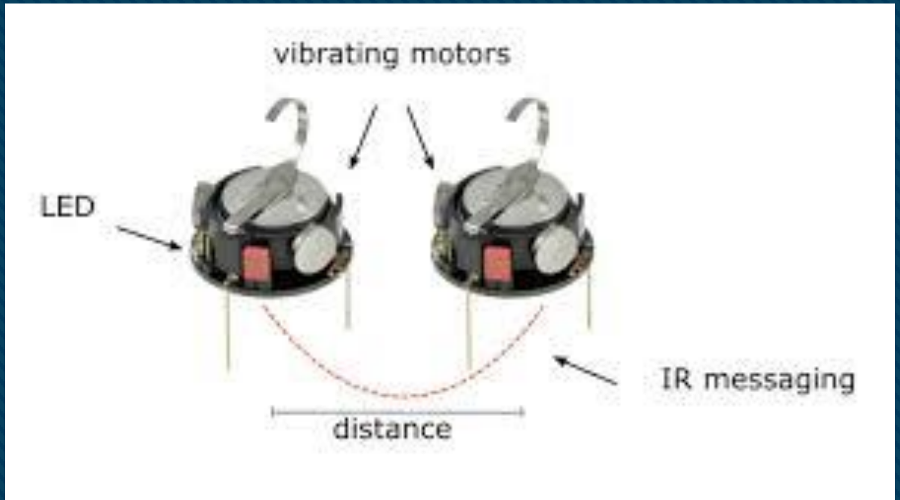
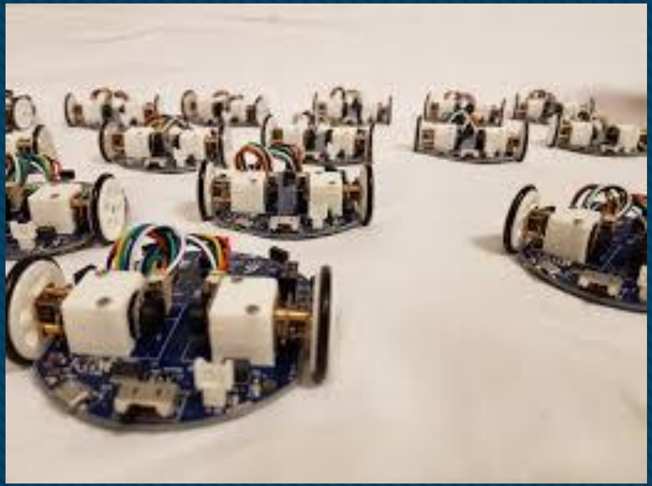


Swarm Robots

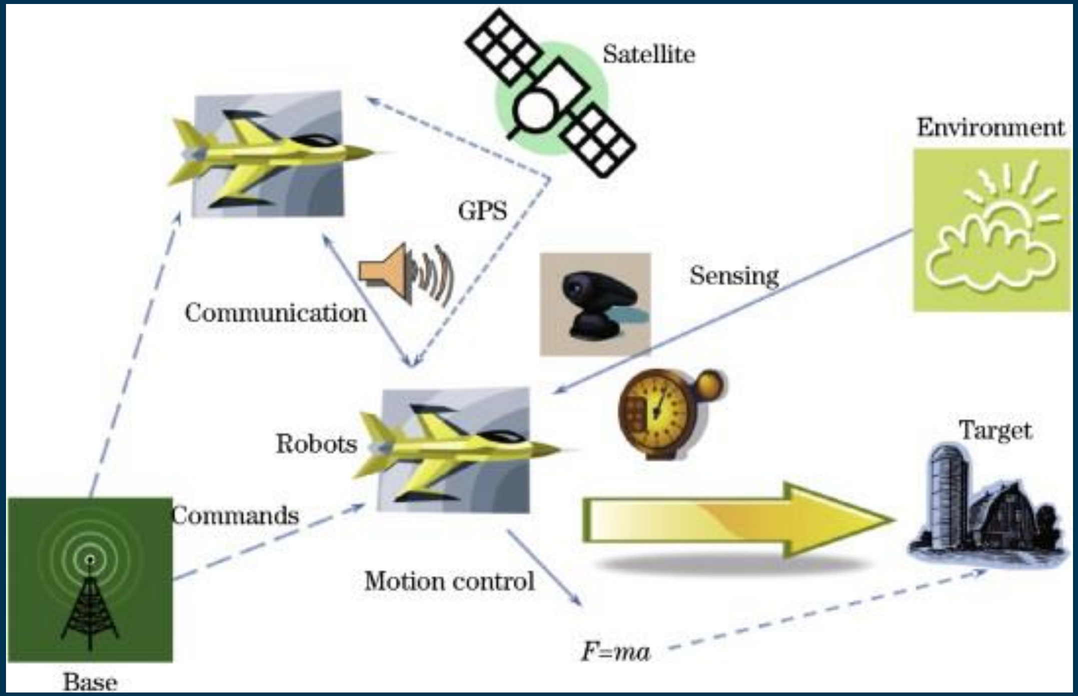
Muhamad Zulfadhli Bin Mohd Zulkiflee

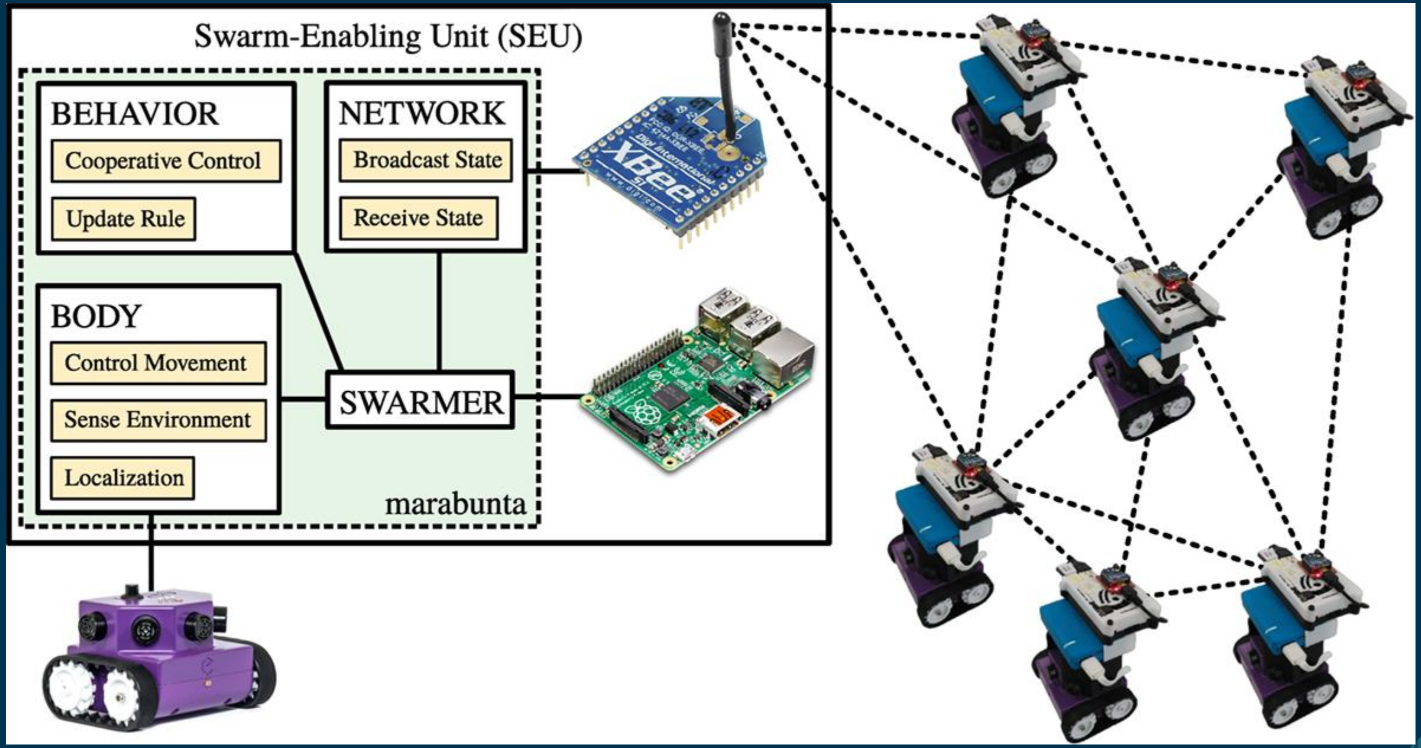


History

- The term ’swarm’ in the context of robotics is applied for the first time by G. Beni and Fukuda in 1988. According to G. Beni, cellular robotics is a system composed of autonomous robots, that operate in a n-dimensional cellular space, without any central entity. Additionally, they have limited communication among themselves, and they coordinate and cooperate to accomplish common goals. On the other hand, Fokuda uses swarm as a group of robots that can work together like the cells of a human body and as a result, they can accomplish complex goals. One year later G. Beni and J. Wang introduces the term of swarm intelligence in relation to cellar robotic systems . They claimed that cellular robotic systems are able to show ’intelligent’ behavior via coordinating their actions.
- In 1993, C. Ronald Kube and Hong Zohng constructed a multi-robot system that was inspired by the collective behaviours of natural swarms. At the same year, Gregory Dudek et al. define swarm robotics with respect to different features, including the size of a swarm, communication range amongst the robots in a swarm, communication topology, communication bandwidth, reorganisation rate of a swarm, abilities of swarm members and swarm homo- or heterogeneity. According to the authors ’swarm’ is a synonym to multirobotic systems, which is why it was still not clear what properties differ the term ’swarm robotics’ from other robotic systems.
- However, in 2004 G. Beni made another attempt to describe a swarm more precisely. According to him the robots in a swarm are simple, identical and self-organizing, and the system must be scalable, and only local communication is available amongst swarm members. These are the properties that are still considered as the basics of defining and distinguishing swarm robotic systems from other robotic systems. The robots used for the experimentation had a lot in common to social insects, for example the simplicity and the decentralization of the system. As a result, the word ’swarm’ was used instead. In the same time period, another research work also dealt with the topic of swarm robotics.
- Further, it is still not clear what size a swarm can or should be. G. Beni gives a brief definition to the size of a swarm as ”It was not as large as to be dealt with statistical averages, not as small as to be dealt with as a few-body problem” . According to the author the size of a swarm should be in the order of 100 – 1023.
- There have been several other definitions of swarms, all of them being similar in the way, that the main idea is to realize natural swarming, including their basic properties like, local interactions and coordination, into real life applications with swarms of robots.

Basic System Architecture





Drone Art

- Drone art (also known as drone display or drone light show) is the use of multiple unmanned aerial vehicles (drones), often quadcopters, flying in a coordinated fashion with light fixtures attached. They are usually equipped with multiple LEDs, and the display held at night. The first drone display was presented in 2012 in Linz/Austria, where the Ars Electronica Futurelab introduced SPAXELS (short for "space elements") for the first time. The displays may be for entertainment, where the drones may use flocking or swarming behaviour. The drones may also be coordinated to produce images. Using this emerging technology, displays have been employed for advertising purposes as well.
- Drone light shows differ from fireworks displays in that drones are reusable, and do not produce air and noise pollution. However, drone displays cannot take place during rain or strong winds.

Robot Design & Task

Flexibility

- Swarm robotics aim to attain a verity of tasks. Here comes the feature of flexibility in focus. For the tasks, the system must be able to create various solutions by coordination and cooperation between robots. So, robots should find solutions by working together and be able to change their roles according to the given tasks. They should be capable of acting simultaneously according to the changes in their environment.

Scalability

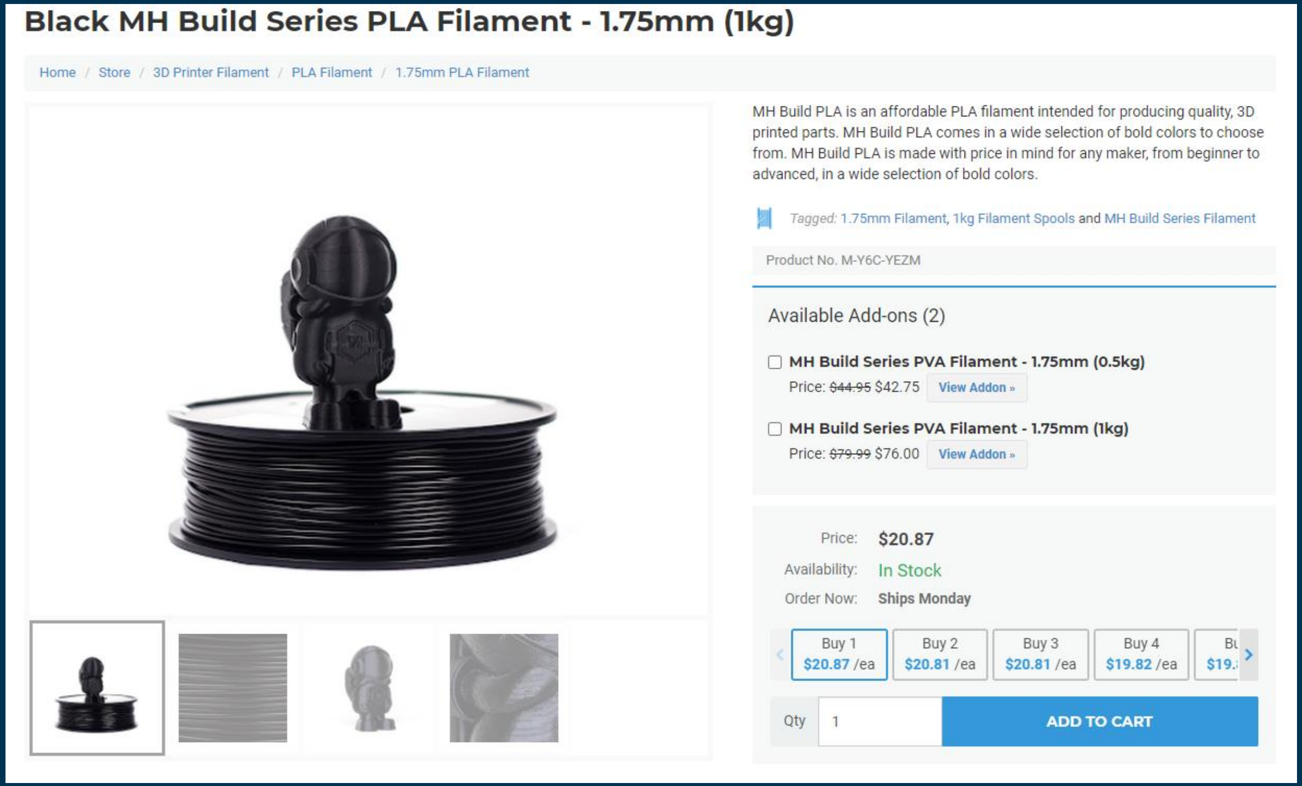
- Scalability means that the systems must be able to work with different sizes of groups. There should not be a global number of robots present in a swarm, but the sizes may differ and accomplishing the task should still be possible and effective. The number of group members must not influence the performance of the system. So, swarm robotic systems should be able to operate with different number of members. The system should work effectively when the swarm size is small and it should support coordination and cooperation amongst the members, if the swarm size is large.

Robustness

- A system is referred as robust, if it has the ability to continue operating even if there are environmental disturbances or system faults. Environmental disturbances may include the changing of the surroundings, addition in the number of obstacles in the environment, weather changes and so on. Some of the system members can have a malfunction or can fail to perform. A swarm robotic system must be able to cope with such circumstances. In swarm robotic systems, individual robots are mainly very simple. This means that they cannot perform any significant tasks alone. So, if a system loses some robots it should not affect the overall performance of the system. The loss of individuals can be compensated by another member and the tasks must go on with the same level of efficiency.

- A swarm robotic system must exhibit several properties that are shown by natural swarms, to realize the idea of natural swarming in the most efficient way.
- One of the way to design the robots that satisfy the properties is using 3D printing. The material used in 3D printing is able to produce such a large number of same design.

PLA(3D Printing Filament)



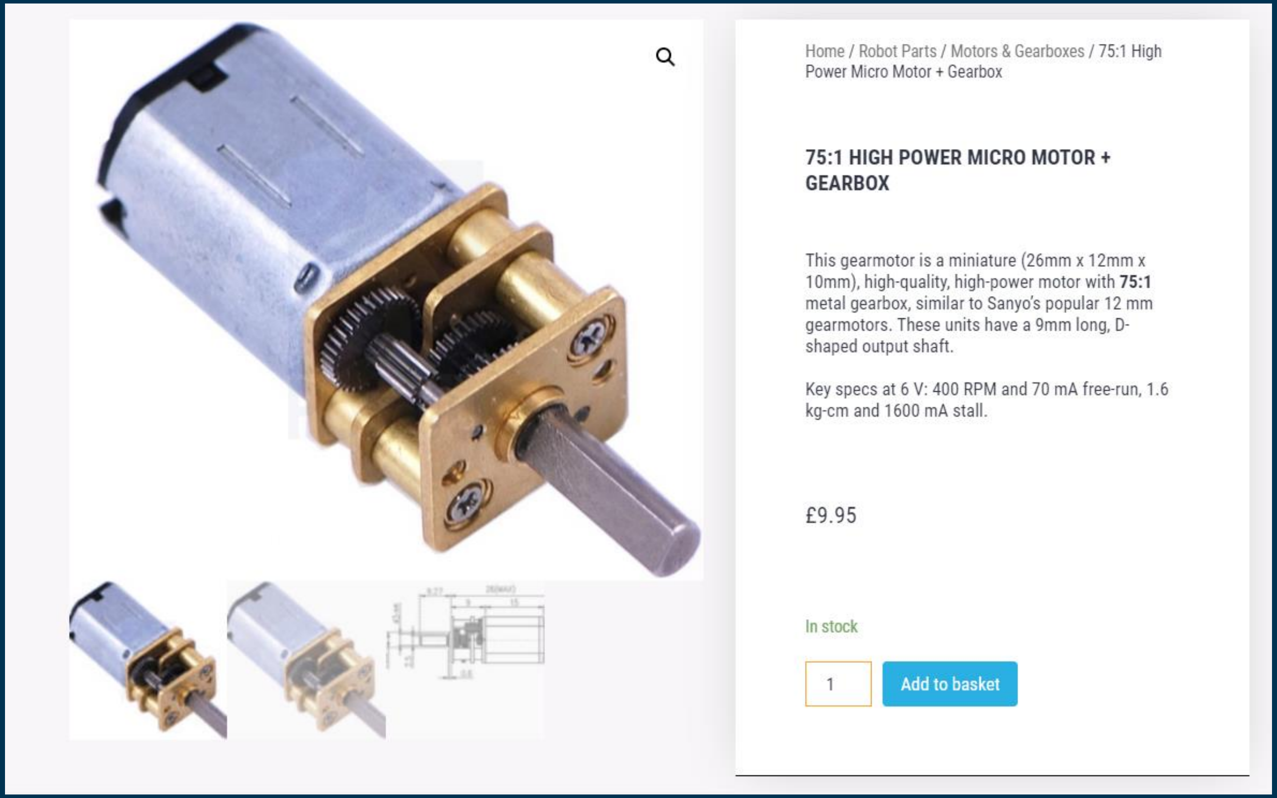
PLA, aka Polylactic Acid, is a multipurpose material commonly used in 3D printing. PLA filament is a bioplastic, which means it is made from renewable natural resources such as corn starch and tapioca products. As a biodegradable material, it is much better for the environment, especially compared to petrochemical-based alternatives. Specifications:

- Recommended Extrusion Temperatures: 205±15°C
- Recommended Bed Temperature: Not needed, but if printer has heated bed, 40±15 °C
- Spool Dimensions (Approx.): 200mm Total Diameter x 50mm Inner Hole Diameter x 65mm Height
- 1 kg spool
- True Diameter: 1.75mm
- Dimensional Accuracy: ±0.05mm
- Density: 1.25 g/cm³
- Volume: 0.80 L
- Length: 332.60 m

Actuator/Locomotion

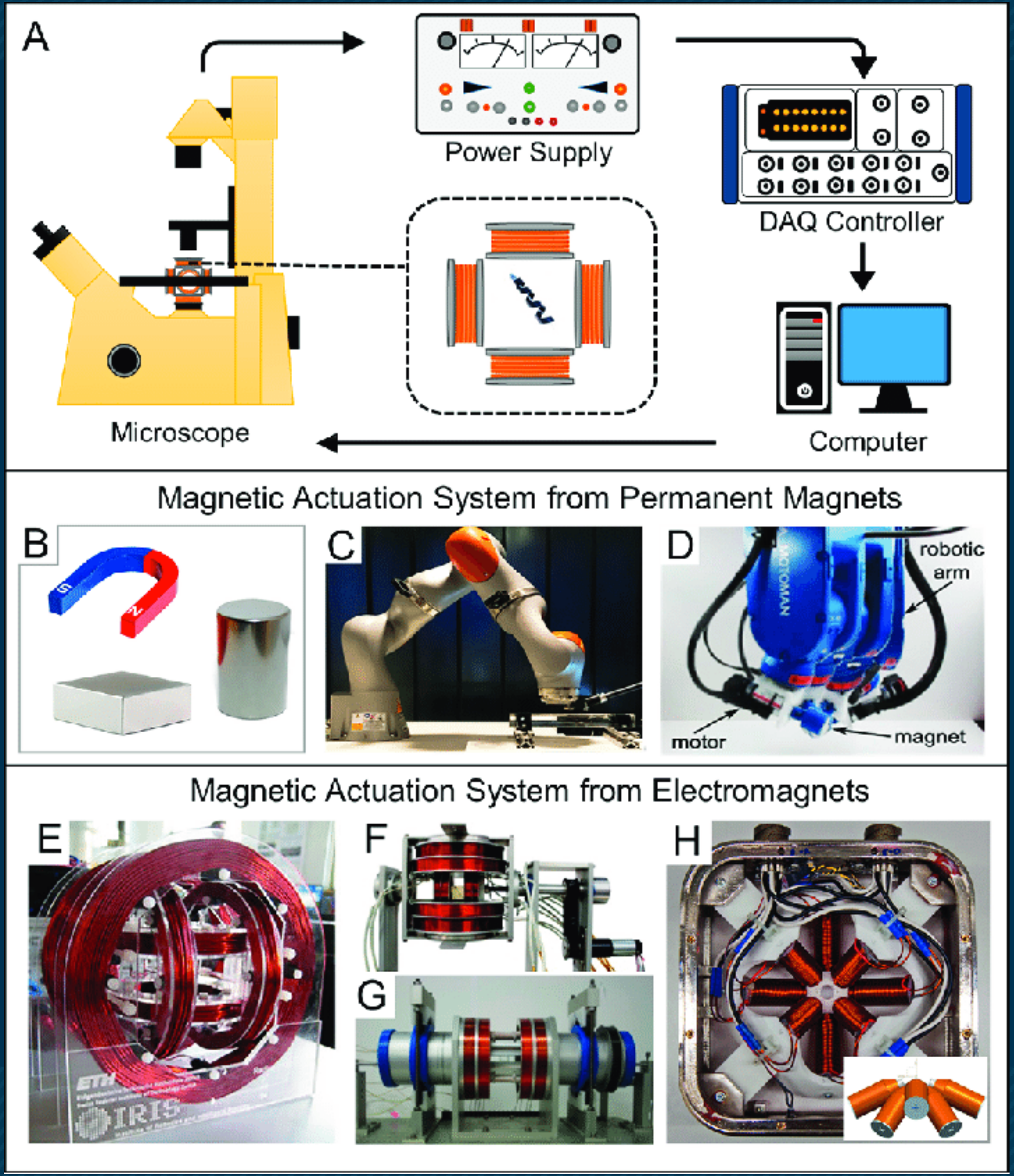
- The goal of a fully autonomous swarm robot team is to self-navigate, grasp objects, and physically interconnect with each other to accomplish self-reconfiguration, self-reassembly, and self-replication by means of a gripper or manipulator. Another goal is the transport of a heavy object from one location to another location in any type of terrain with the help of locomotion units such as wheels, tracks, treels (track/wheel combinations), or legs (quadrupedal, hexapedal, etc.).

DC Motor



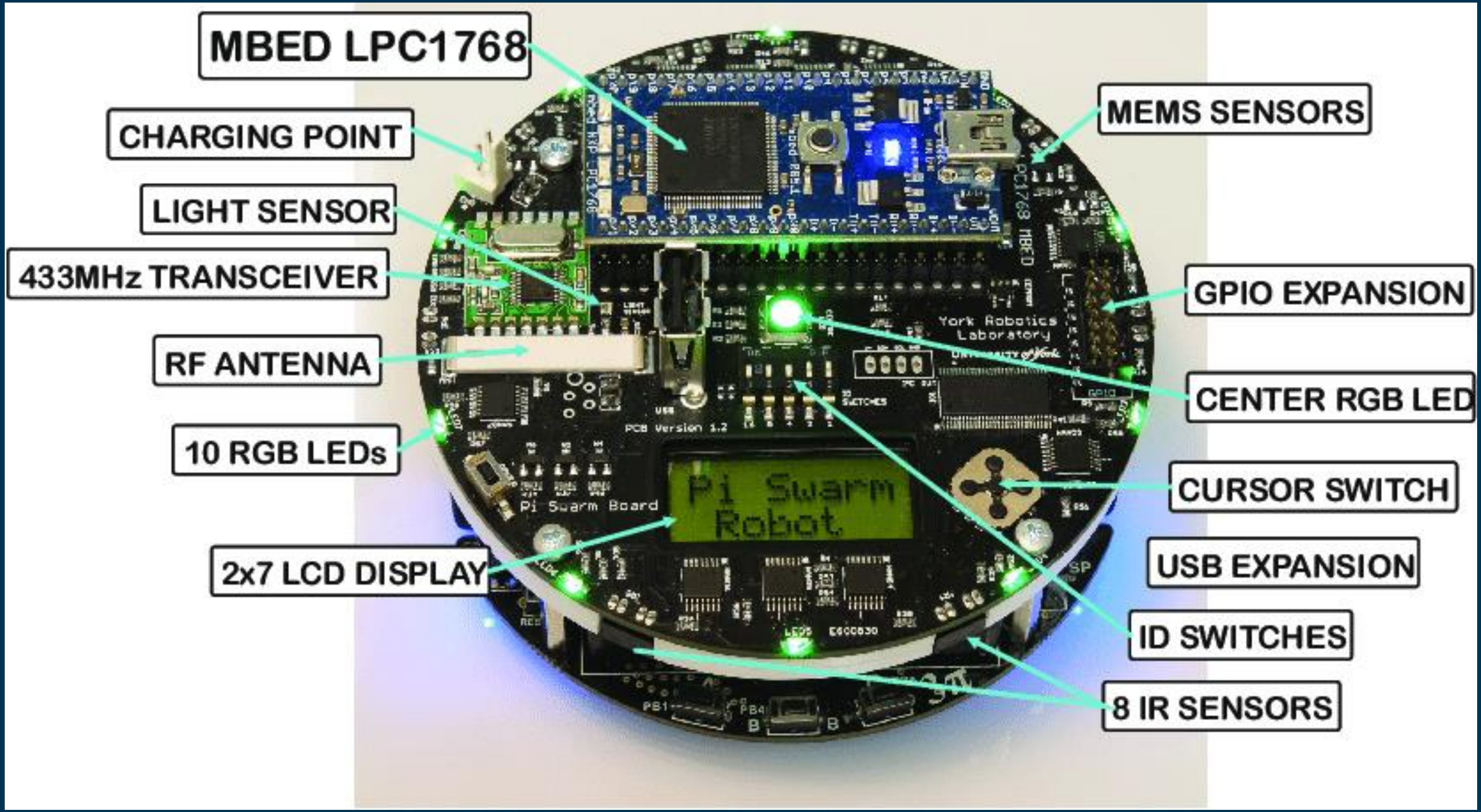
- Grippers are used as manipulators in almost all swarm robots, both for interconnection with other swarm robots and for grabbing (grasping) objects. Such grippers are usually operated by a DC motor.
- This gearmotor is a miniature (26mm x 12mm x 10mm), high-quality, high-power motor with 75:1 metal gearbox. These units have a 9mm long, D-shaped output shaft.
- Key specs at 6 V: 400 RPM and 70 mA free-run, 1.6 kg-cm and 1600 mA stall.
- This motor has a long (0.365″ or 9.27 mm), D-shaped metal output shaft, and the brass faceplate has two mounting holes threaded for M1.6 screws (1.6 mm diameter, 0.35 mm thread pitch). It weighs approximately 0.35 oz (10 g).

Electro-Permanent Magnets Actuator

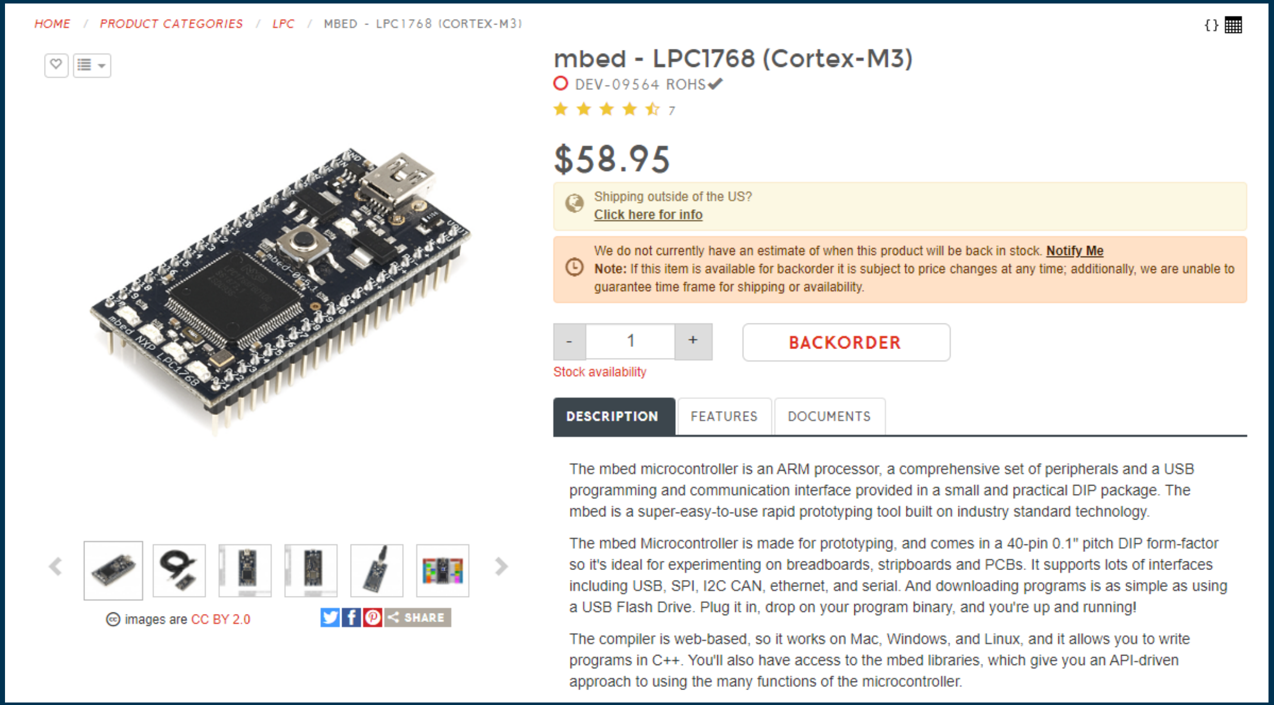


Experimental setup for magnetically driven micro/ nanorobots and various magnetic actuation systems.

Navigation System & Controller



LPC1768 Microcontroller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mbed - LPC1768 (Cortex-M3)

DEV-09564 ROHS✔

7

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Note: If this item is available for backorder it is subject to price changes at any time; additionally, we are unable to guarantee time frame for shipping or availability.

- 1 +   BACKORDER

Stock availability

DESCRIPTION   FEATURES   DOCUMENTS

The mbed microcontroller is an ARM processor, a comprehensive set of peripherals and a USB programming and communication interface provided in a small and practical DIP package. The mbed is a super-easy-to-use rapid prototyping tool built on industry standard technology.

The mbed Microcontroller is made for prototyping, and comes in a 40-pin 0.1" pitch DIP form-factor so it's ideal for experimenting on breadboards, stripboards and PCBs. It supports lots of interfaces including USB, SPI, I2C CAN, ethernet, and serial. And downloading programs is as simple as using a USB Flash Drive. Plug it in, drop on your program binary, and you're up and running!

The compiler is web-based, so it works on Mac, Windows, and Linux, and it allows you to write programs in C++. You'll also have access to the mbed libraries, which give you an API-driven approach to using the many functions of the microcontroller.

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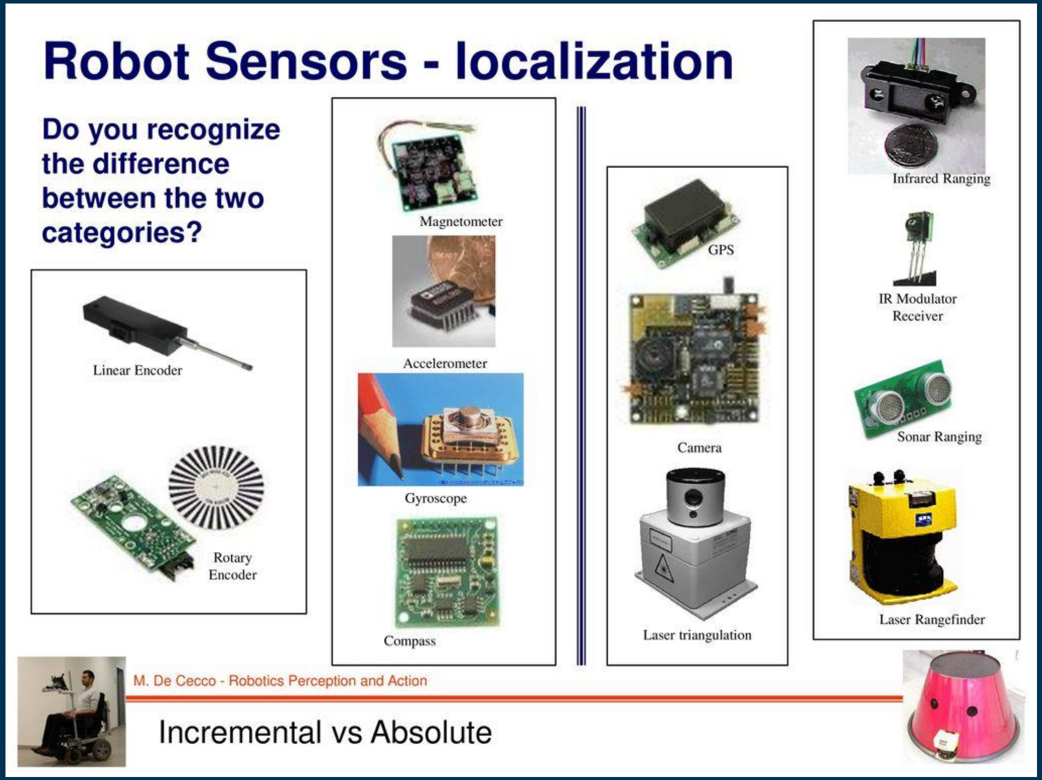
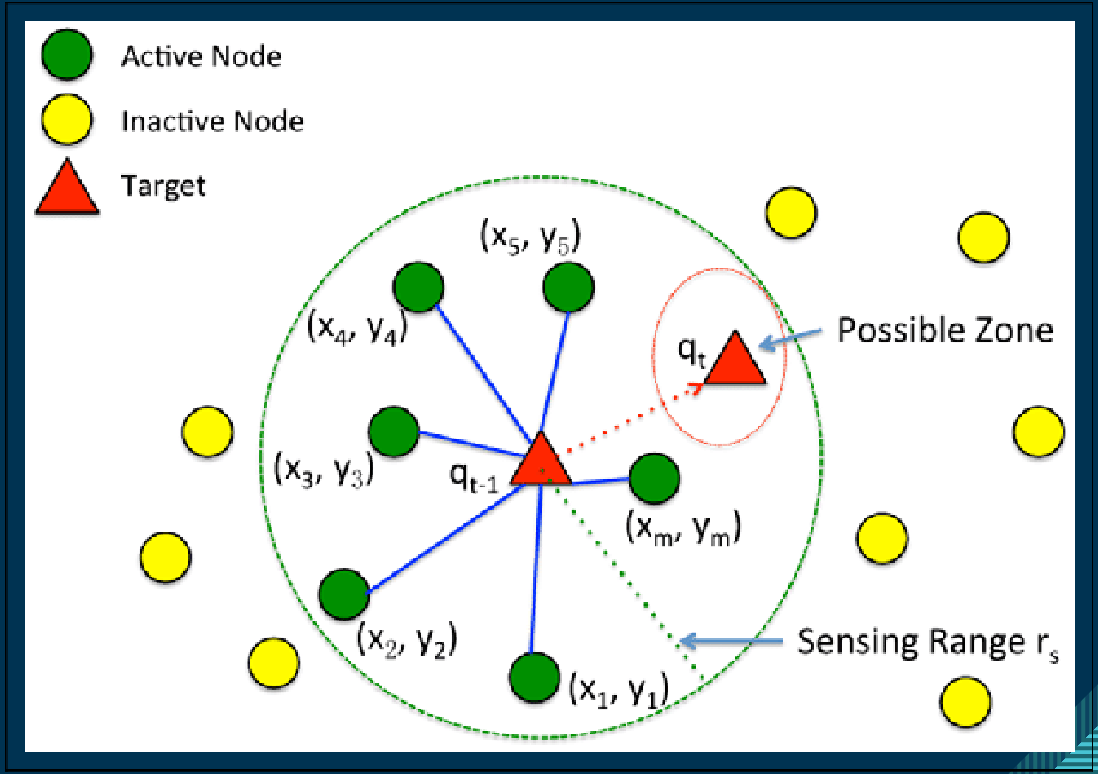
- Convenient form-factor: 40-pin DIP, 0.1-inch pitch
- Drag-and-drop programming, with the board represented as a USB drive
- Best-in-class Cortex-M3 hardware:
- 100 MHz ARM with 64 KB of SRAM, 512 KB of Flash
- Ethernet, USB OTG
- SPI, I2C, UART, CAN
- GPIO, PWM, ADC, DAC
- Easy-to-use online tools:
- Web-based C/C++ programming environment
- Uses the ARM RealView compile engine
- API-driven development using libraries with intuitive interfaces
- Comprehensive help and online community
- 44mm x 26mm

Data Collection

Localisation Sensor

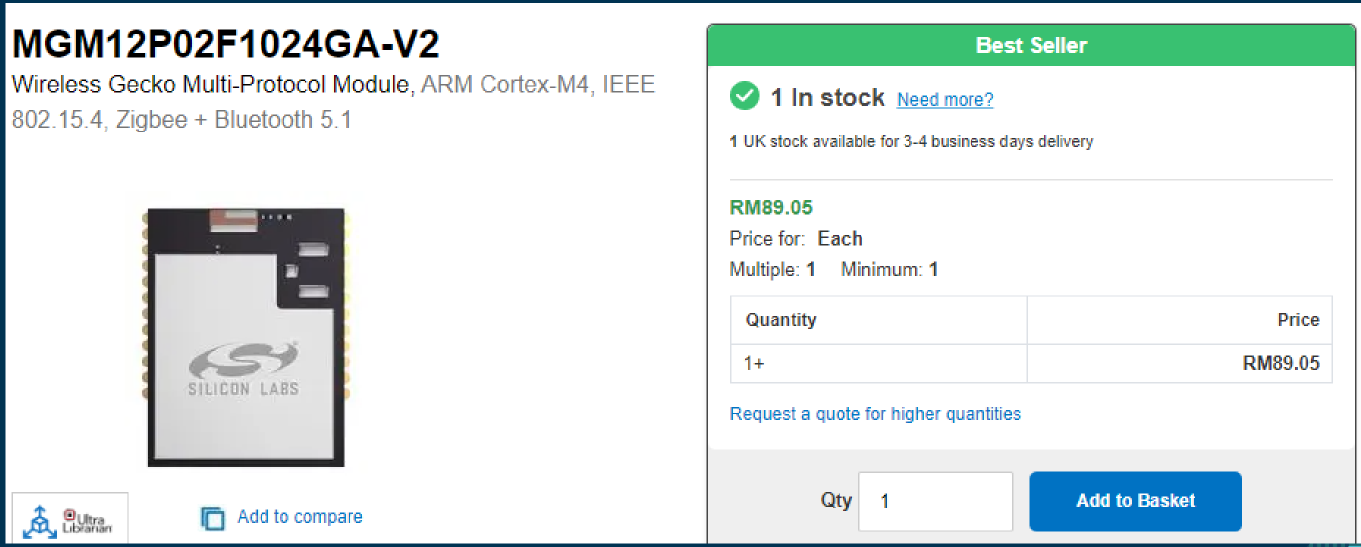




Data Transmission

Wireless mesh networks (WMNs)

- High performance 32bit 40MHz ARM Cortex®-M4 with DSP instruction and floating-point unit
- 1MB of flash, 256KB of RAM, 2.5GHz radio opertaion, +10dBm maximum TX power, antenna
- Pin compatible with MGM111 module, dimension is 12.9mm x 17.8mm x 2.3mm (W x L x H)
- 12 channel peripheral reflex system, low energy sensor, multichannel capacitive sense interface
- Autonomous hardware crypto accelerator and true random number generator
- General purpose CRC, true random number generator, SAR ADC, 2 x ACMP, 3 op-amp, IDAC
- Robust peripheral set and up to 25 GPIO, 1.8V to 3.8V power supply, -40°C to 85°C temperature range
- Hardware cryptographic acceleration for AES 128/256, SHA-1, SHA-2 (SHA-224 and SHA-256) and ECC
- 2 x UART/SPI/SmartCard (ISO 7816)/IrDA/I2S), low energy UART (LEUART™), I2C, 2 x watch dog timer
- Shaped OQPSK, 2-FSK / 4-FSK modulation with fully configurable shaping



Power System Management

Rechargeable Lithium Batteries

- Max. continuous discharge current: 22 Amp
- Peak discharge theoretic, 4 sec : 38.5 Amp
- Nominal Capacity: 2000mAh
- Nominal Voltage 1pcs: 3.6v - 4.2V
- Battery internal resistance: 18 ohms
- Rechargeable: Yes
- Dimensions : 18mm x 65mm
- Approximate Weight : 43g

Click Image for Gallery

LiPo Rechargeable Battery 11.1V 5200mAH

★★★★★ 18 Ratings

Brand: China

Login to view ProMaker's Insider Price!

RM180.00

10 or more RM172.80
50 or more RM162.00
Cashback: RM5.40
CytronCash Balance: Login

Availability: 1

- 1 +

Accessories you may need

Enter desired quantity before clicking 'Add to Cart' button

Multi-Function LIPO Balance Charger
RM89.00 ~~RM95.00~~

Specification:

- Ordinary Voltage: 11.1V
- Fully-charge Voltage: 12.6V
- Capacity: ~~5000mAh~~ 5200mAh
- Discharge rate: 30C
- Able to use for most of the 12V controllers, motors or any other appliances
- **Must** charge with designated LiPo Battery Charger
- Please check the Wikipedia link about Li-Po Battery.
- Dimension: 145mm x 45mm x 28mm