SWARM ROBOTICS

1. Inspired from the natural; phenomenon of swarm of insects or ants.
2. The term swarm represents a collection of physical bots and they are designed to perform collectively.
3. Interaction takes place between the bots and between the bots and environment

MULTI-ROBOTICS SYSTEM (MRS)

1. In this case multiple bots interact with each other in order to solve a complex problem.
    - Generally, when we try to solve a complex problem and we design a bot to solve the particular then we need to a make a such bot which can tackle complex situations.
    - But the problem is that we need to spend more money and resources in order to build a such bot which is multifunctional.

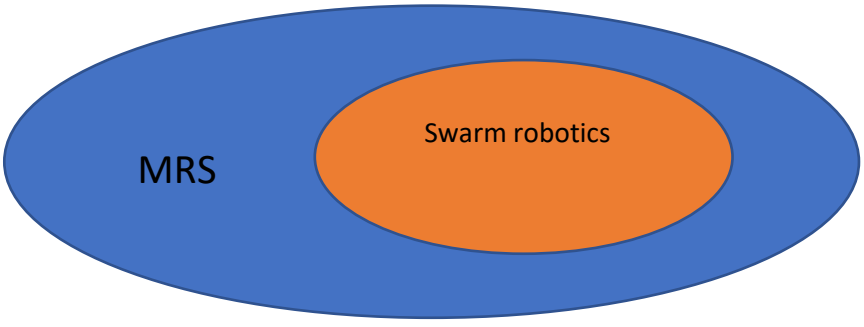
❖ The solution is:
Decentralization
We can make multiple bots in order to tackle individual tasks.
There will be communication between the bots regarding tasks and it is cost effective also.

We can say that an individual bot tackling a complete complicated task is a resemblance with monolithic programming and MRS is the resemblance of modular programming.

ADVANTAGES: -

1. Cost effective
2. Easy to find errors
3. Easy to fix errors

DIFFERENCE BETWEEN MRS AND SWARM ROBOTICS



Swarm robotics is the subset of Multiple robotics system.
In MRS we can take heterogenous and homogenous bots.
In Swarm robotics we can only take homogenous bots.

WIRELESS COMMUNICATION BETWEEN ARDUINOS

1. Used when working on a microcontroller project

Two ways to communicate: -

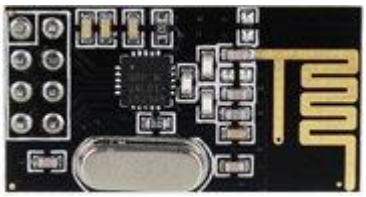
1. Wired communication
2. Wireless communication

The wireless communication can be achieved by WIFI GSM /GPRS, Bluetooth RF
Among above RF is the most common one.

The communication module we use in this case is **NRF24L01** communication module.

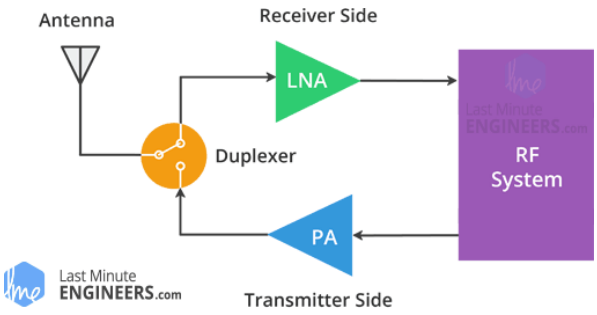
Version1

1. Low cost
2. Bi- directional
3. Band-width 2.4GHz (ISM-Industrial Scientific and medical standard)
4. Ultra-low power
5. Communication over a distance 100m



Version 2

1. Integrated with PA/LNA
   Comes with special RFX2401C Chip
   PA (Power Amplifier) boosts the power of the signal being transmitted
   Basically, LNA collects the extremely weak and uncertain signal from the antenna and amplifies to a useful level



Here we can spot a duplexer which prevents the overloading of two signals of PA over LNA

Communication

1. Positive
2. Negative
    a. Data is lost
    b. Acknowledgement is lost

Positive

When the sender sends the data the receiver receives the data.

In return the receiver sends an acknowledgement and on receiving the ACK the transmitter sends the next data packet.

The time gap for the transmitter to wait for the ACK is 130microseconds

Negative

Case1

When the data is lost.

The transmitter sends the data and due to interruption, the data is lost and due to which the receiver doesn't sends the ACK.

On not receiving the ACK the transmitter waits for ARD (Auto-Retransmit-Delay) time and then resends the data and if received the receiver sends back the ACK

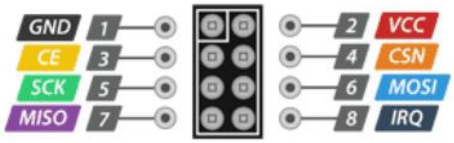
But it causes interruption on the transmitter side.

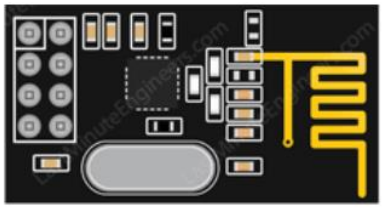
Case2

When the ACK from the receiver is lost.

The sender waits for ARD and then sends another packet of data

PIN ARRANGEMENTS





SPI

The Serial Peripheral Interface is a synchronous serial communication interface specification used for short-distance communication, primarily in embedded systems.

1. CE- (Chip enable)
   nRF24L01 will either transmit or receive (Mode selected)
2. CSN (Chip Not Selected)
   Active-LOW pin (Default HIGH)

   When this pin goes low, the nRF24L01 begins listening on its SPI port for data and processes it accordingly.
3. SCK accepts clock pulses provided by the SPI bus Master.
4. MOSI (Master out Slave In) is SPI input to the nRF24L01.
5. MISO (Master In Slave Out) is SPI output from the nRF24L01.
6. IRQ is an interrupt pin that can alert the master when new data is available to process.

	MOSI	MISO	SCK
Arduino Uno	11	12	13
Arduino Nano	11	12	13
Arduino Mega	51	50	52

Establishing connection between two Arduinos A and B
Code for A (Sender)
https://drive.google.com/file/d/1FtsotTkPHWfCerUhditwVE3Vfu4K3eZL/view?usp=sharing

Code for B (Receiver)
https://drive.google.com/file/d/1l1E5dc7GRVc1rIVAD-pI0UByWhv9NF4e/view?usp=sharing

BIBILOGRAPHY

1. https://www.researchgate.net/publication/258405159_An_Introduction_to_Swarm_Robotics
2. https://robotics.stackexchange.com/questions/7363/what-is-the-difference-between-multiple-robots-and-swarm-robots#:~:text=Swarm%20Robots%3A%20Historically%2C%20some%20of,swarm%20systems%20have%20to%20homegeneous.
3. https://www.researchgate.net/publication/235939781_A_Review_of_Research_in_Multi-Robot_Systems
4. https://www.electronics-lab.com/project/communication-between-two-arduinos-using-nrf24l01/
5. https://maniacbug.github.io/RF24/classRF24.html

----------XX----------

Name:- Rajat Kumar Nayak