MCTE 4362 ROBOTIC HARDWARE SYSTEM

SWARM ROBOTS

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Introduction

- Swarm robots are a type of robotic system consisting of multiple autonomous robots that work together as a coordinated group.
- These robots communicate and collaborate with each other to perform tasks more efficiently than a single robot or a centralized system.

Use of Swarm Robots

Search and Rescue

Environmental Monitoring

Agriculture

Construction

Surveillance and Security

Mapping and Exploration

History of swarm robot

The concept of swarm robotics draws inspiration from the behavior of social insects like ants, bees, and termites, which work together in large groups to accomplish complex tasks.

1980s

The concept of swarm robotics emerged as researchers sought to understand and replicate the collective behavior of social insects.

1990s

Early experiments in swarm robotics focused on simulating swarm behavior using computer models.

2000s

Researchers began exploring real-world applications of swarm robots, such as cooperative transportation and environmental monitoring.

2005

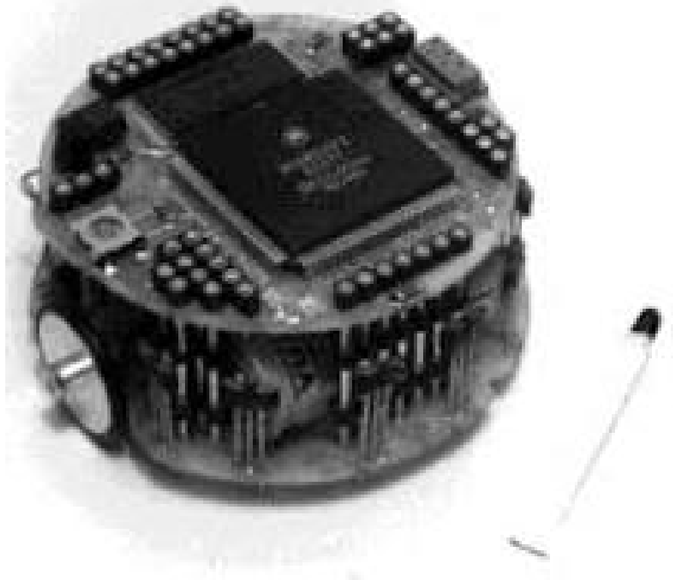
Kilobot system was introduced, which allowed for the creation of large-scale swarms with low-cost, small robots.

Current

Advanced communication protocols, decentralized decision-making algorithms, and bio-inspired designs.

The first physical swarm robot, called "Khepera,"

The Khepera is a small (5.5 cm) differential wheeled mobile robot that was developed at the LAMI laboratory of Professor Jean-Daniel Nicoud at EPFL (Lausanne, Switzerland) in the mid 1990s. It was developed by Edo. Franzi, Francesco Mondada, André Guignard and others.



System Components of Swarm Robots

Robot Agents

Each individual robot in the swarm is called a robot agent. These agents are typically small and simple in design.

Each robot agent is like a little worker that helps in getting things done.

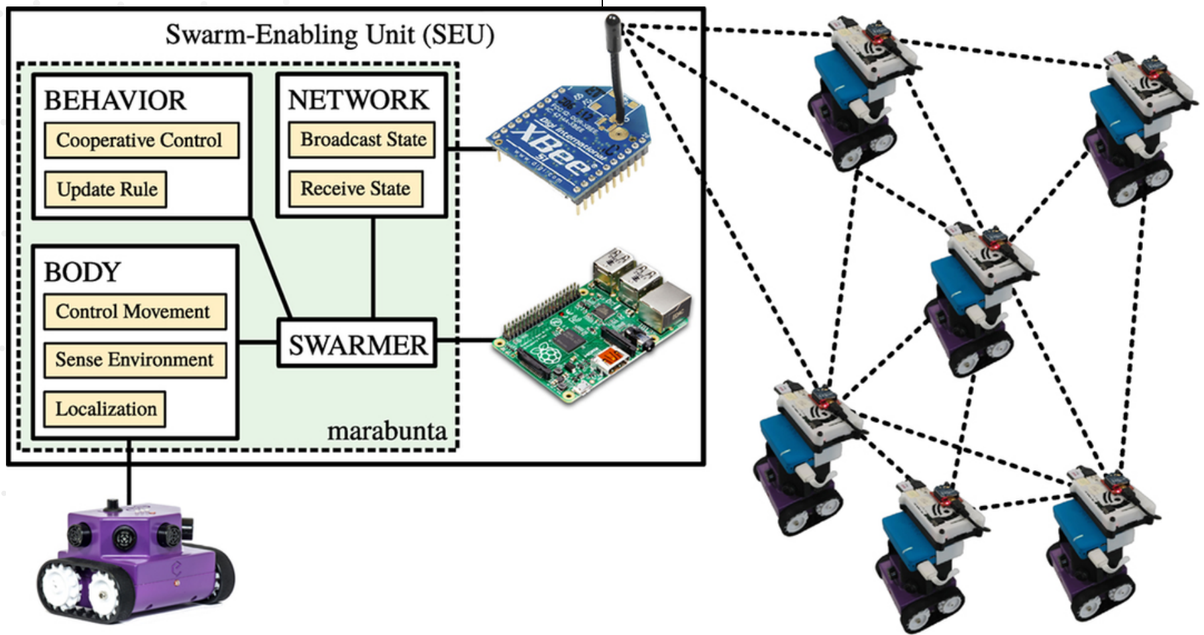
They work together as a team to solve problems and complete tasks.

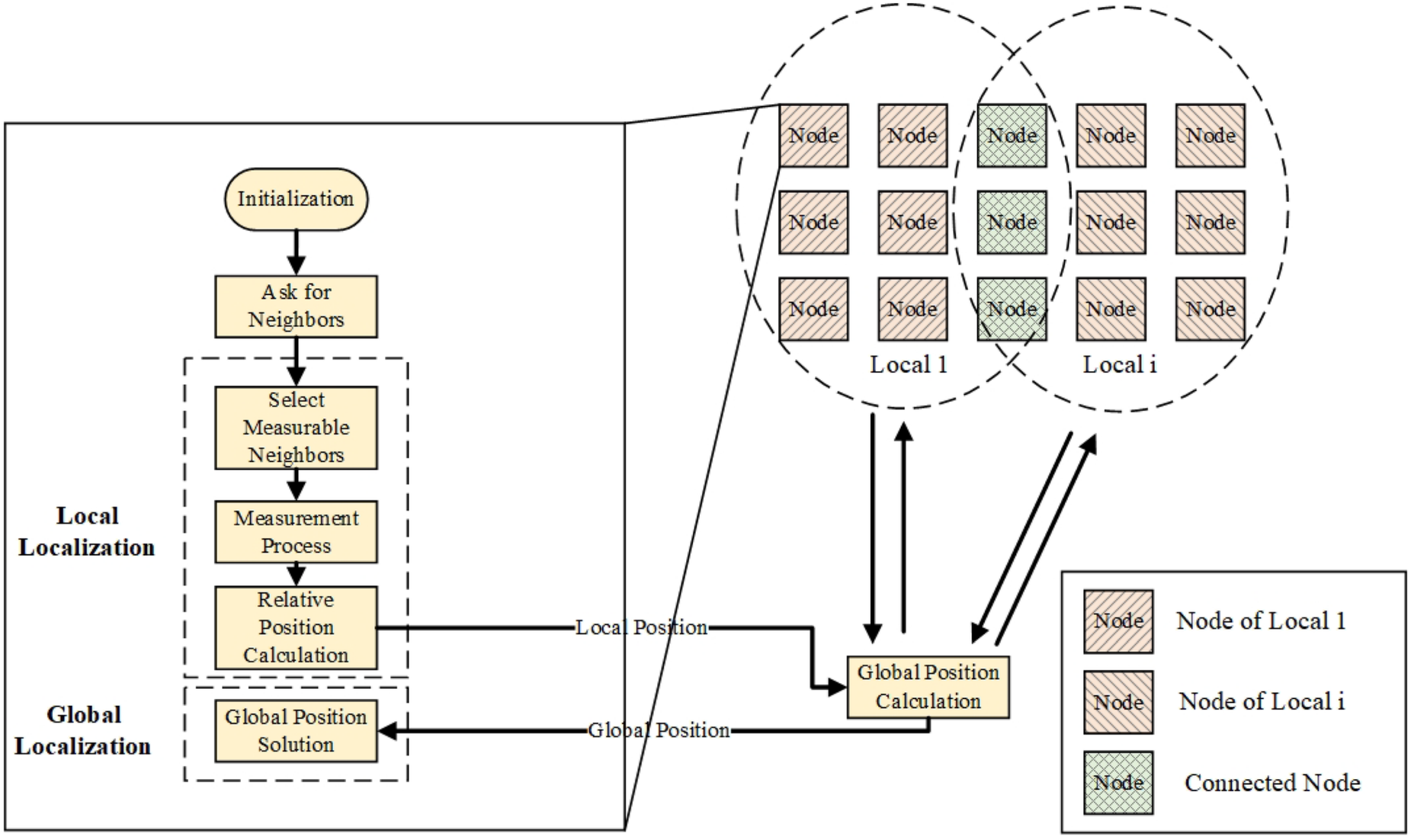
Sensing and Perception

Swarm robots have sensors to perceive their environment. These sensors may include cameras, proximity sensors, or range finders, enabling the robots to detect obstacles, other robots, or specific objects.

Localization

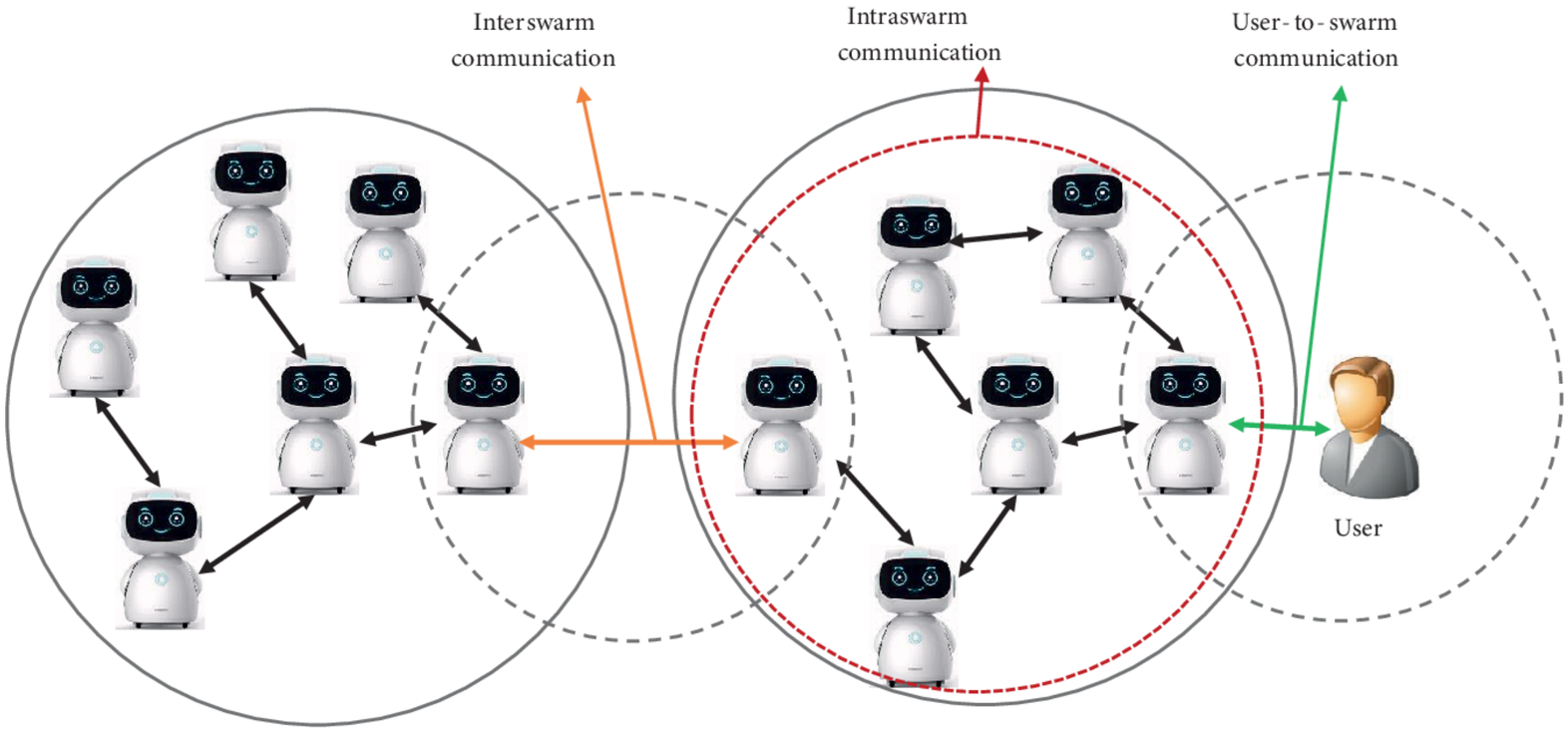
Swarm robots need to know their own position and the positions of other robots in the swarm. Localization techniques like GPS or relative positioning using inter-robot communication are employed.




Initialization
Ask for Neighbors
Select Measurable Neighbors
Measurement Process
Relative Position Calculation
Local Localization
Global Localization
Global Position Solution
Local Position
Global Position
Global Position Calculation
Node
Local 1
Local i
Node of Local 1
Node of Local i
Connected Node

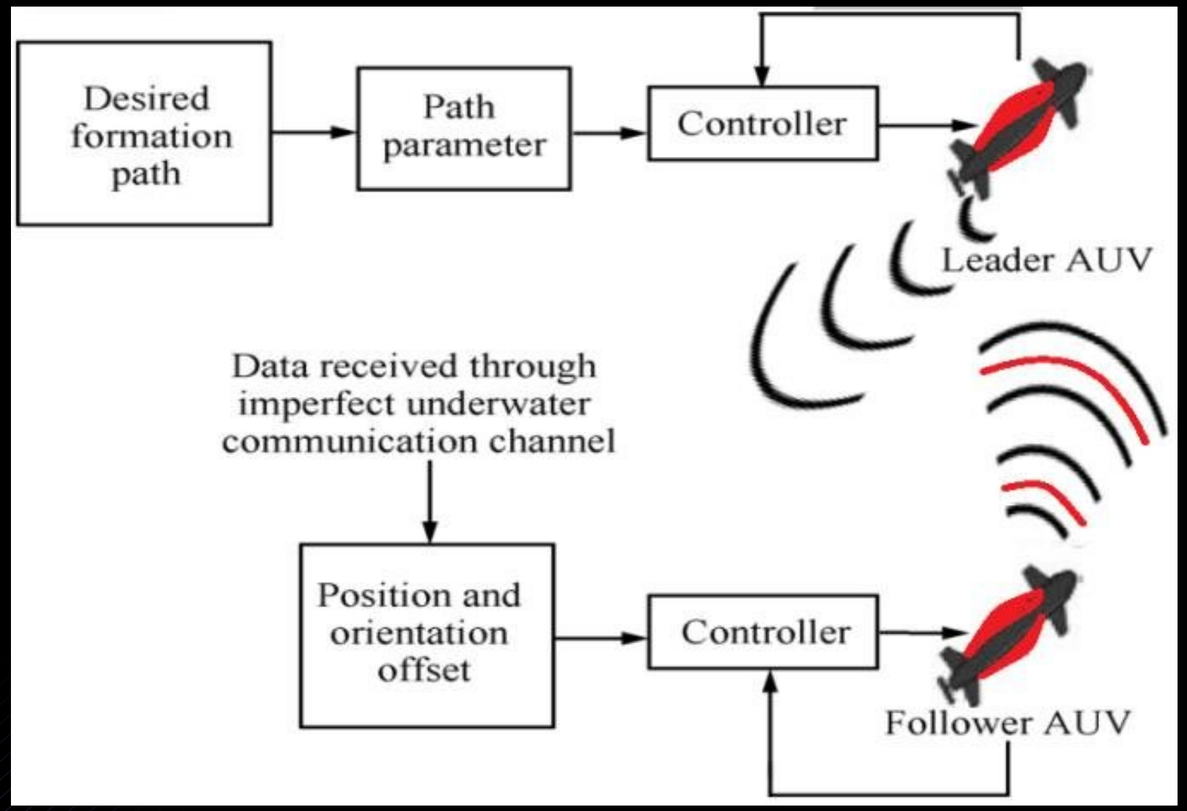
Communication

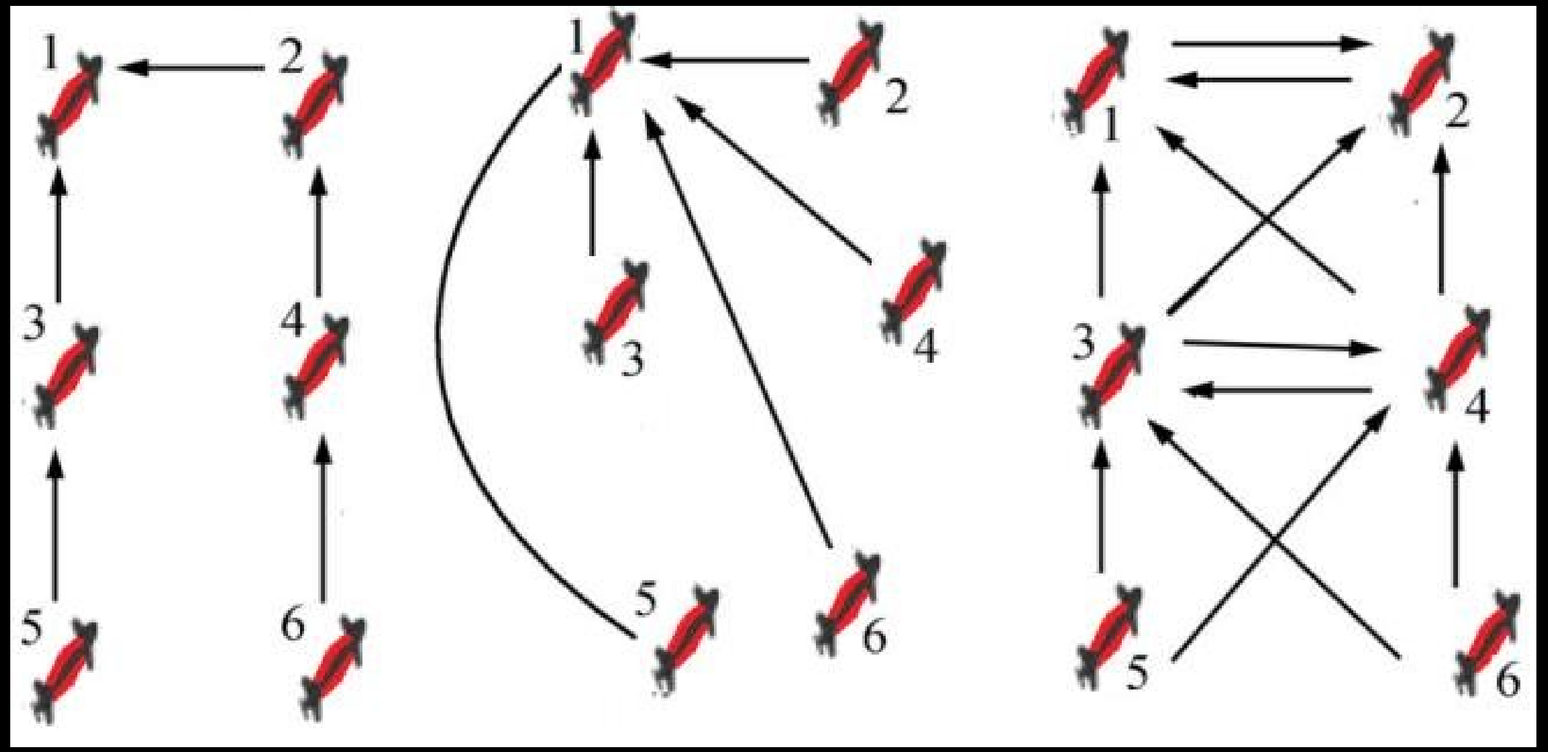
- Robot agents need to talk to each other to share information and work together.
- They use special ways of talking, like using wireless signals or infrared lights.
- It's like they have a secret language to understand each other.



Control and Coordination

Algorithms and control mechanisms are used to coordinate the actions of the swarm. These algorithms can be based on simple rules or complex distributed algorithms to achieve emergent behaviors.





warm robot's neighbors Reference formation Control and Coordination for communication

Hardware of Swarm Robots

Chassis

The physical body of a swarm robot is usually compact and lightweight, allowing it to move easily in various environments.

Power Source

Swarm robots require a power source, which can be batteries or rechargeable energy systems.

Actuators

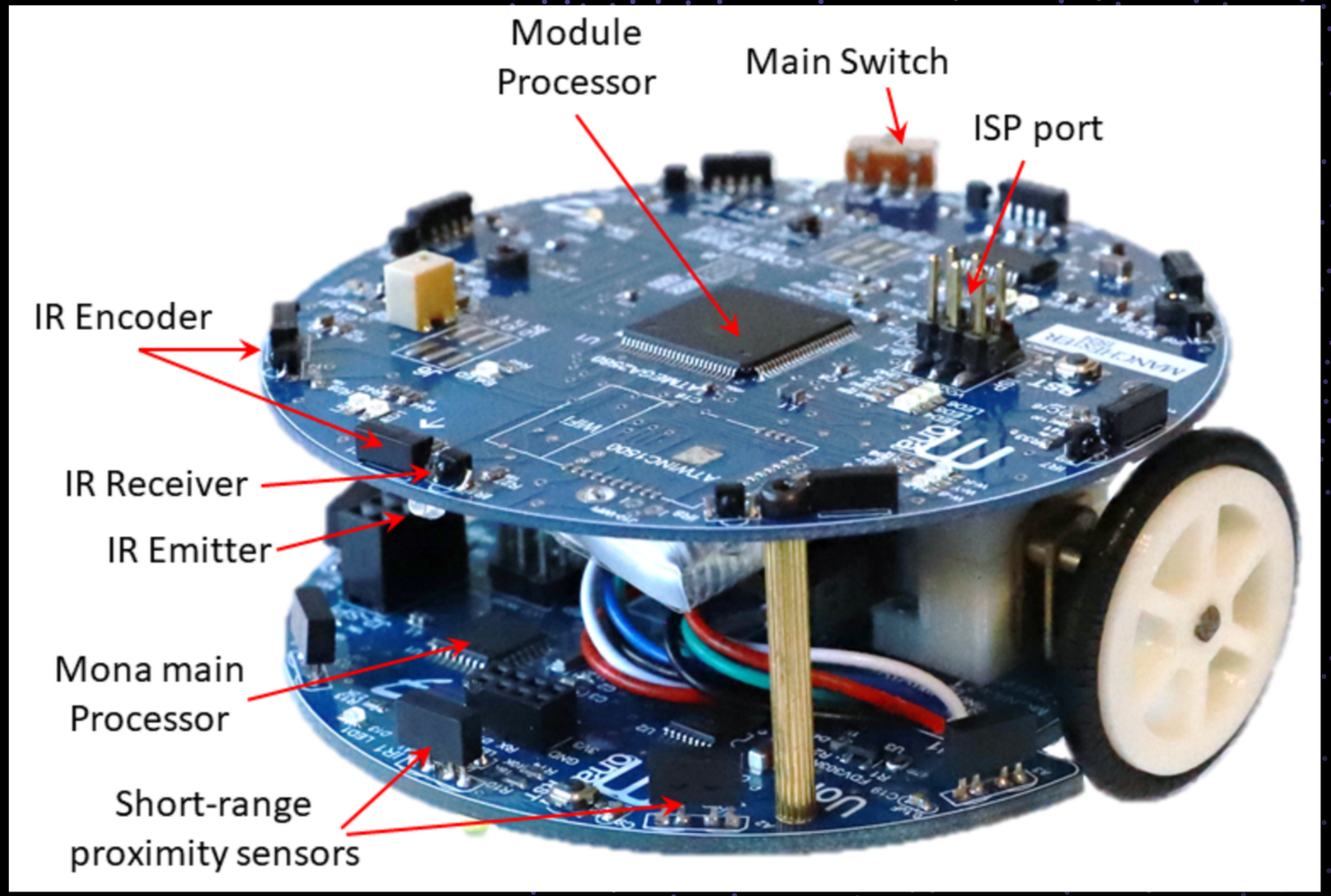
Swarm robots have actuators such as motors or servos to enable locomotion and manipulation of objects.

Onboard Computer

Each robot is equipped with a small onboard computer that processes sensor data, executes control algorithms, and communicates with other robots.

Communication Modules

Swarm robots have communication modules, such as wireless transceivers, to exchange information with other robots in the swarm.


Module
Processor
Main Switch
ISP port
IR Encoder
IR Receiver
IR Emitter
Mona main
Processor
Short-range
proximity sensors