Automatic Fault tolerance in Sensor Networks using TMR (Triple Modular Redundancy)

Motivation

Sensors Cheap but Unreliable

Failure can be fatal

Approach

Use redundancy to get correct value using TMR.

Detect the absence of the node.

Detect the wrong value from faulty node.

Agree on one single value.

Selection of a Leader

Leader selected as the one with largest remaining battery power.

Each node multicast their remaining battery level.

One with the maximum battery level is selected.

In case of a tie, one with lower node id is selected.

Responsibility of a Leader

Send the control message to actuators if present.

Send the message about the status of nodes to PC/Controller.

Get the message from the PC/controller to change the threshold and disseminate the information to all other nodes in the cluster.

Faulty Leader

Declare itself as faulty.

Reinitiate the selection of new leader for the cluster.

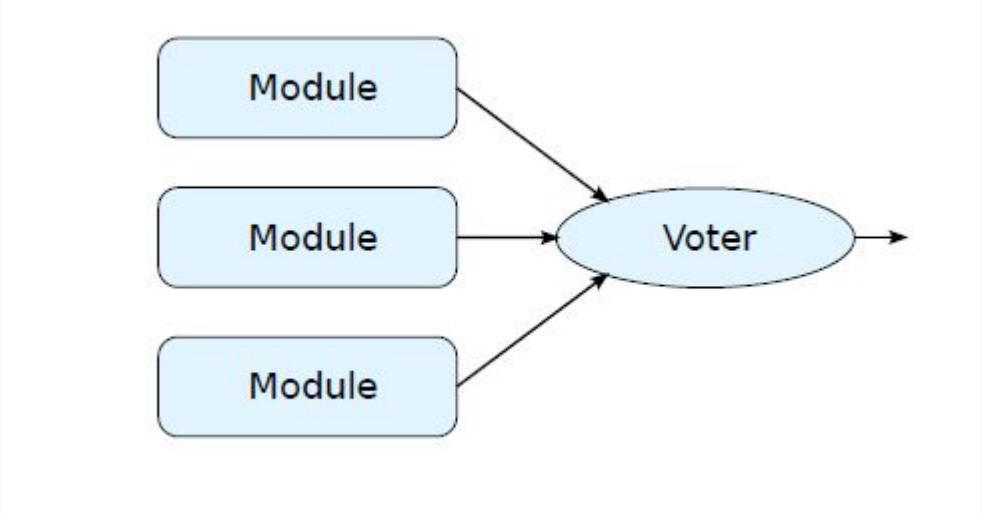
Fault Tolerance: TMR

Leader can be the voter.

More than 2 modules needed.

Majority have almost same data.

Data from majority used.



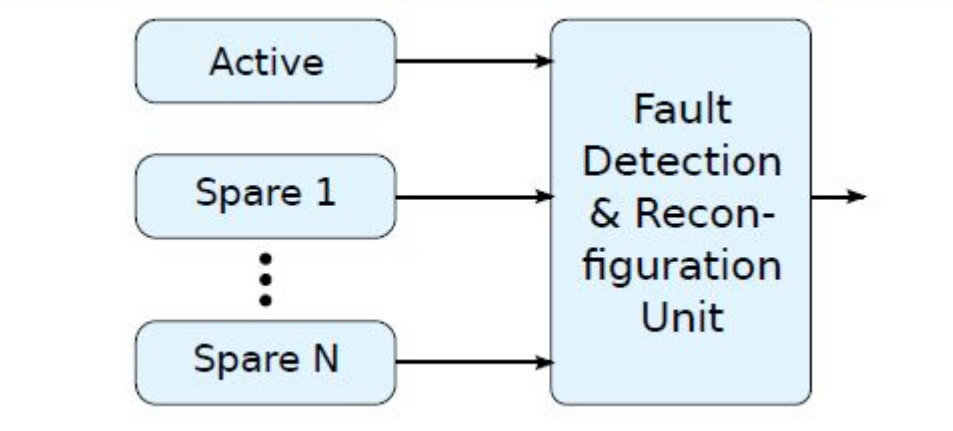
Source: https://isis.tu-berlin.de/course/view.php?id=6235

Fault Tolerance: Multiple standby modules

Attach multiple standby modules.

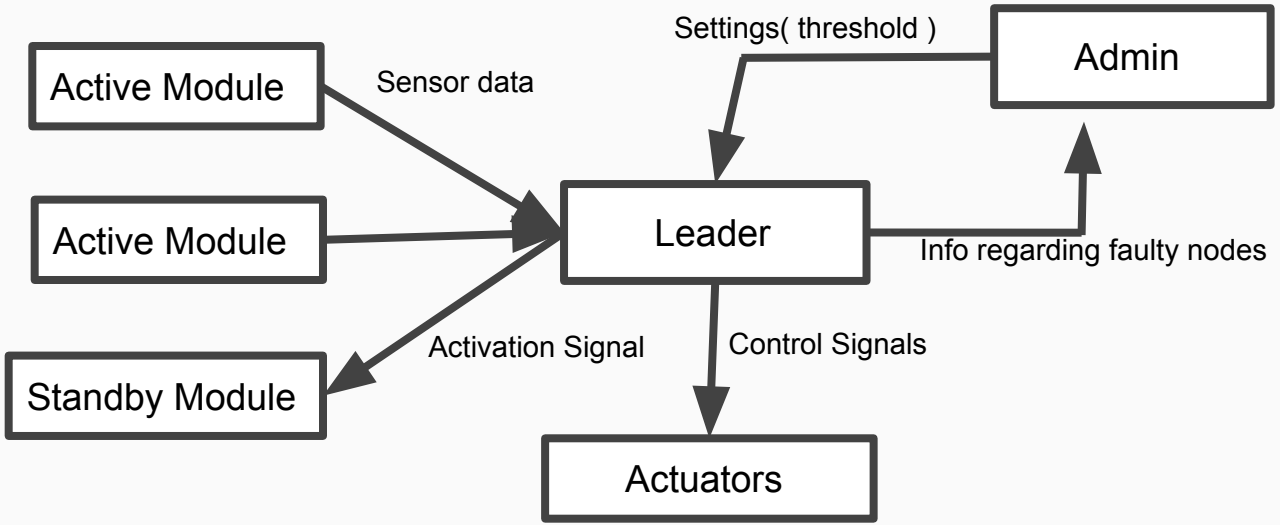
If a node gives wrong data, replace it.

Inform admin about faulty node.



Source: https://isis.tu-berlin.de/course/view.php?id=6235

Block Diagram



Hardware Needed

3-4 Sensors data.

1 border router.

1 PC for admin controller.

1 Actuator(Led or anything) for demo.

Batteries for the sensors to check the amount of battery needed.

Division of Work

MD. Atiqur Rahaman Khan Nirjhor: Python code for creating UI for admin panel, interact with leader to change settings and get information regarding the faulty node to aware the user.

Binayak Ghosh: Selection of leader. Monitor the battery status of the leader and reinitiate leader selection if the battery of current leader is getting low. Interact with actuators. Implement the standby modes for the actuators.

Niroj Pokhrel: Implementation of Triple modular Redundancy to detect the error. Activation signals to standby modes to change its state to active and start sending data.

THANK YOU