Frog-Inspired Humidity-Responsive Brain Sensor

Prelims - *Current events of national and international importance | Science & Technology*

Why in News?

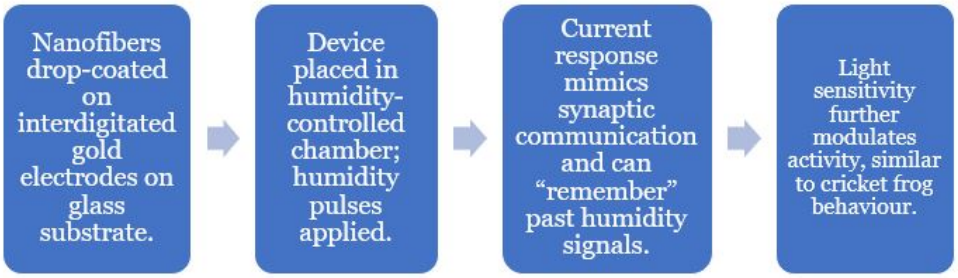
Researchers at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, have developed a frog-inspired neuromorphic sensor that responds to humidity and light.

Key Features -

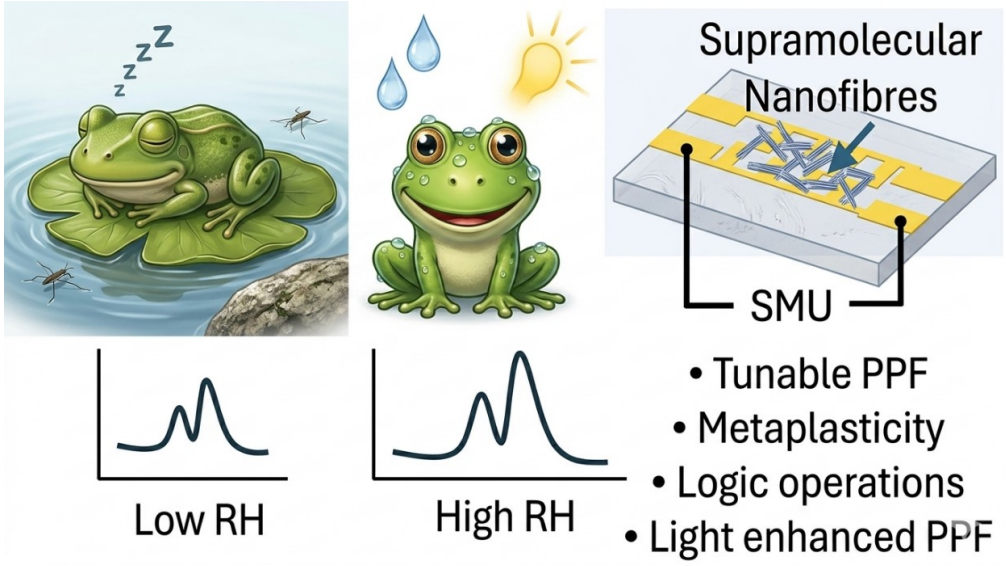
- It is a type of ***advanced electronic device*** designed to mimic the way a biological brain processes information *(Biological Mimicry).*
- **Technology Type –** Neuromorphic sensor.
- **Biological Inspiration –** Cricket frogs, whose synaptic behaviour is highly sensitive to moisture and daylight.
- **Material Base –** One-dimensional supramolecular nanofibers.

  Supramolecular nanofibers are one-dimensional nanostructures formed through the self-assembly of small molecules or polymers.

- **Primary Stimulus –** *Humidity* (first neuromorphic device to use moisture as main trigger).
- **Secondary Stimulus –** *Light* (modulates sensitivity).
- **Functions –** Sensing, memory storage, and signal processing simultaneously.
- **Synaptic Functions Replicated –** Facilitation, depression, meta-plasticity, and basic logic operations.



- **Procedure –**



- **Conventional vs Frog-Inspired Sensor –**

Aspect	Von Neumann Bottleneck (Conventional Systems)	Frog-Inspired Neuromorphic Sensor
Data Handling	Separate units for sensing, memory, and processing → requires constant data transfer.	Integrates sensing, memory, and processing in a single platform.
Energy Use	High energy consumption due to repeated transfer between CPU, memory, and sensor.	Low energy use by computing at the source (edge computing).
Response Mode	Always-on, continuous operation → drains battery.	Event-driven response → fires only when stimulus detected.
Efficiency	Slower, less efficient due to transfer delays.	Brain-like efficiency → simultaneous sensing, storage, and processing.
Biological Analogy	Mechanical separation of functions unlike natural systems.	Mimics frog synapses → adaptive, moisture/light-sensitive behaviour.

- **Significance - Smart Environmental Monitoring -** Adaptive sensors for humidity/climate changes.
- **Healthcare Devices -** Wearables that sense sweat/breathing with ultra-low power.
- **AI (Artificial Intelligence) and IoT (Internet of Things) -** Supports sustainable edge computing, reducing reliance on power-hungry server farms.
- **Global First -** First neuromorphic device using humidity as primary stimulus.

Reference

PIB | Neuromorphic Sensor

