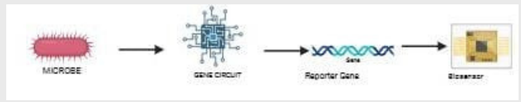
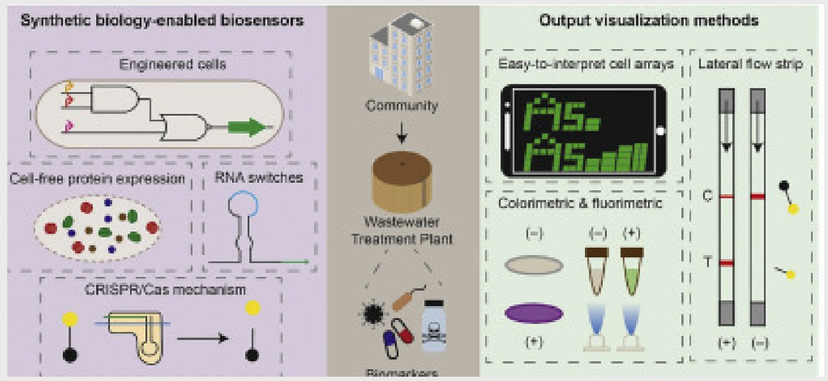
Engineering Living Biosensors

Integrating Bio-Computing Principles for Sustainable Environmental Monitoring





INTRODUCTION

1. The increased environmental pollution has led to a demand for more sustainable, **cost-effective**, and **sensitive detection** technologies.

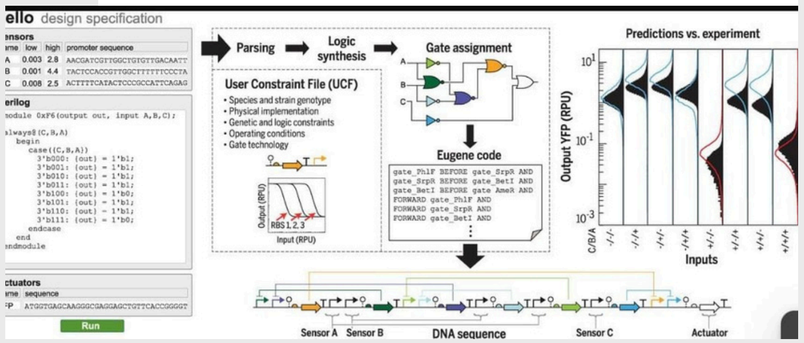
2. Traditional sensor system relies on chemical assays or electronic devices, often **NON-BIODEGRADABLE**. In contrast, living biosensors can be engineered to specific environmental cues.

3. Through the engineering of a genetic circuit, it can be programmed to perform logical operations.

OBJECTIVE

Develop living microbial biosensors integrating bio-computing principles for **real-time, eco-friendly detection** of pollutants.

These biosensors aim to **mimic digital logic operations** within cells for sustainable environmental monitoring.



METHODOLOGY

SELECT MICROBE	**Select a microbial strain ex . ECOLI**
DESIGN GENE CIRCUIT	**DESIGN GENE CIRCUIT**
ADD REPORTER GENE	**Create logic based genetic circuit (AND /OR/NOT)**
TEST & CALIBERATE	**Expose the engineered microbe to a pollutant for response and record the results**
DEPLOY BIOSENSORS	**Immobilize microbes in hydorgel and films**

RESULTS /FINDINGS

- Bio-computing enables programmable and **adaptive detection systems.**
- Biosensors are biodegradable, self-replicating, and low-energy, aligning with **green chemistry principles.**
- Potential applications: industrial waste monitoring, water testing, and environmental surveillance.

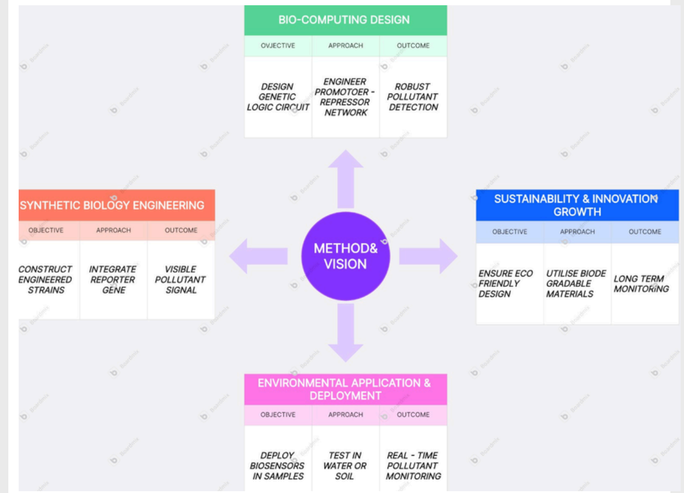
DISCUSSION

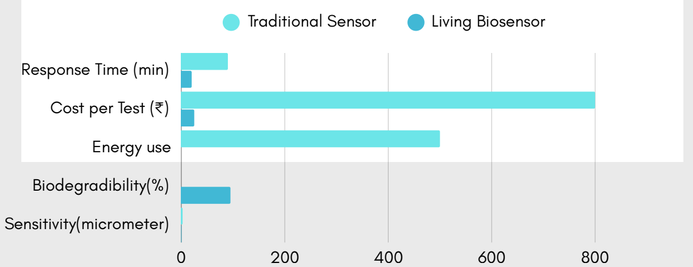
- Bio-computing enables i**ntelligent, logic-based pollutant** detection.
- Living biosensors offer eco-friendly, **low-energy sensing** compared to electronic systems..
- Supports sustainable, real-time monitoring aligned with global green goals.
- Future scope: **IoT integration, multi-pollutant and cell-free systems.**

Logic Gate	Input Condition (Pollutant Presence)	Output Signal (Fluorescence or Color Change)	Interpretation
AND Gate	Input Condition (Pollutant Presence)	High GFP fluorescence (green)	Both pollutants detected simultaneously
OR Gate	Input Condition (Pollutant Presence)	Moderate fluorescence	Either pollutant present
NOT Gate	Input Condition (Pollutant Presence)	No fluorescence / baseline color	Clean environment

ANALYSIS

- Integrates synthetic biology with computational logic for smart sensing.
- Uses gene circuits to convert **chemical signals into visual outputs.**
- Provides a green, low-cost alternative to traditional detectors.
- Enables autonomous, scalable and sustainable monitoring systems.





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