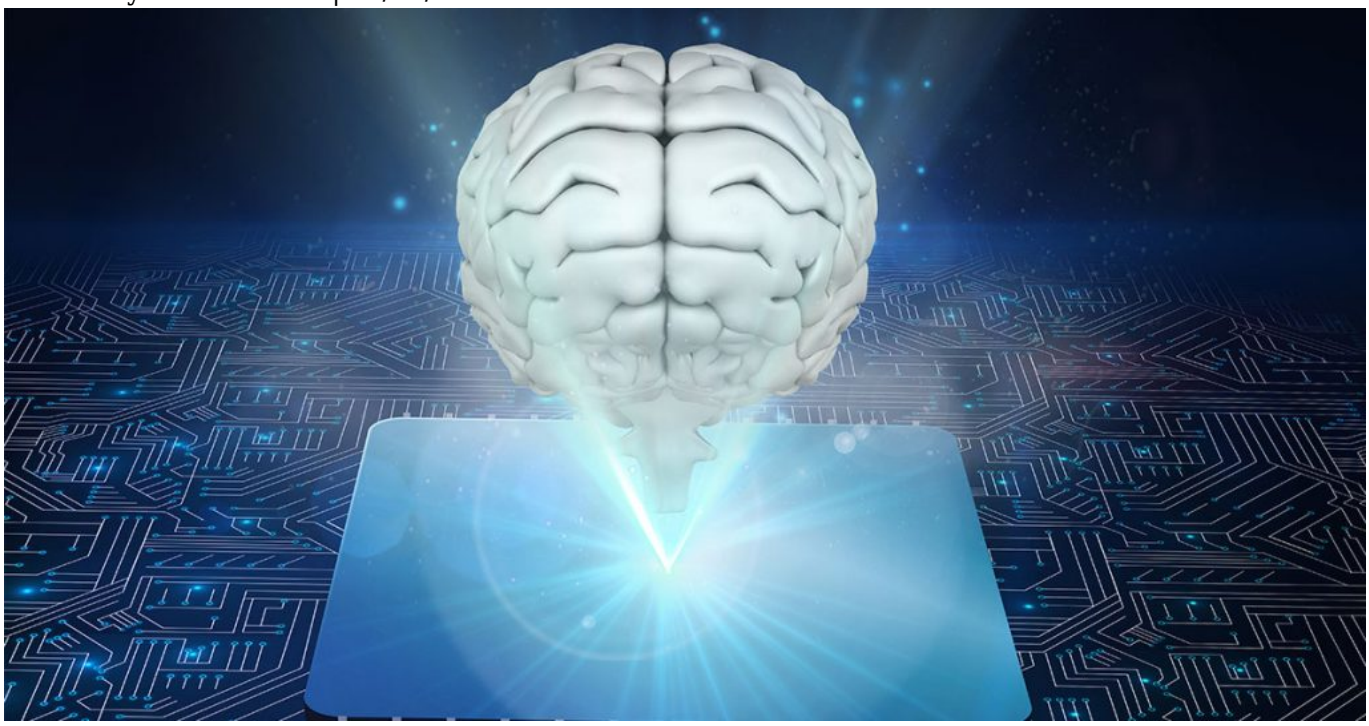
Organoid Intelligence

written by iasexam.com | 09/03/2023



Context- A recent plan for a potentially ground-breaking new field of study known as "organoid intelligence" aims to create "biocomputers" in which 3D brain cultures grown in the laboratory are connected to real-world sensors and input/output devices.

Key Highlights

- It is anticipated that technology will harness the brain's processing power and comprehend the biological foundations of human cognition, learning, and a variety of neurological disorders.
- Human stem cells are used to construct these "mini-brains," which can be as small as 4 mm in size and mimic many of the structural and functional characteristics of a developing human brain. It is utilized in drug testing and the study of human brain development.
    - However, because they lack the necessary sensory inputs and blood circulation for the development of a complex organ like the human brain, brain organoids created in the laboratory are not advanced enough.
- In addition, researchers transplanted organoid cultures from human brains into rat brains and observed that these cultures established connections with the rat brain and displayed functional activity.
    - Brain disorders could be studied in humans using this system.
    - But the organoids are still in the microenvironment of the rat brain, which might not be like the human brain.

What is the new “bio-computer”?

- In the future, “bio-computers” will be made by combining brain organoids with current computing techniques and machine learning.
- Organoids with multiple electrodes that can record the firing patterns of neurons and mimic sensory stimuli will be grown inside structures.
- Then, methods from machine learning will be used to investigate how neuron response patterns affect human behavior or biology.
- Human neurons have already been grown on a microelectrode array and trained by scientists to produce electrical activity similar to that of table tennis electrons.

What Opportunities Are There for “Bio-Computers”?

- Drug development for conditions like Parkinson’s disease and microcephaly can be aided by brain organoids made with stem cells from people with these conditions.
- By comparing the data on brain structure, connections, and signaling between healthy and patient-derived organoids, these organoids can provide insights into the biological basis of human cognition, learning, and memory.
- While human minds are slower than PCs at basic number-crunching, they eclipse machines at handling complex data.

Future Directions

- At the moment, brain organoids have a diameter of less than 1 mm, which is about three millionths of a human brain. Therefore, increasing the brain organoid’s size is essential for increasing its computing power.
- Using “Big Data” infrastructure, neural recordings from each neuron and connection will be required for storage and analysis.
- Microfluidic systems for transporting oxygen and nutrients and removing waste products will also need to be developed by researchers.
- Throughout the course of this work, it is also necessary to identify, discuss, and evaluate ethical issues as they arise.