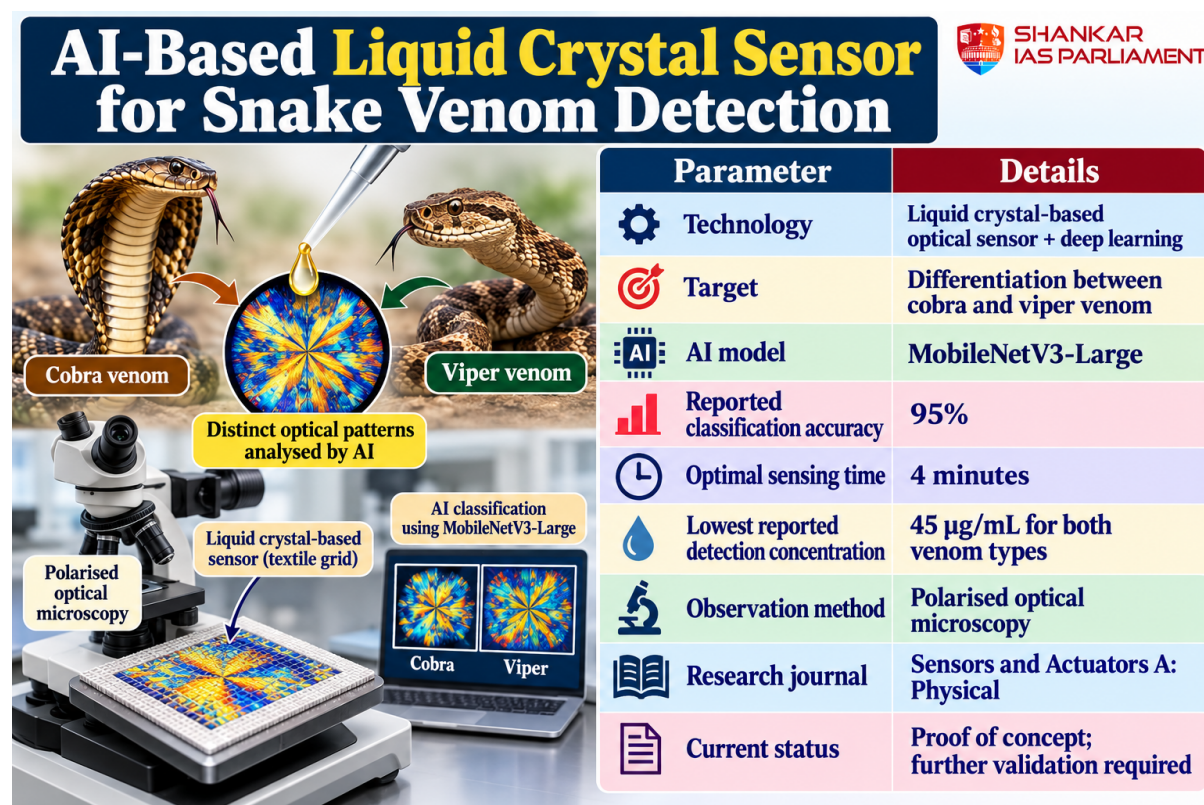


AI-Based Liquid Crystal Sensor for Snake Venom Detection

Prelims: Current events of national and international importance | Health | Science & Technology

Why in News?

Recently, researchers have developed a liquid crystal (LC)-based sensor integrated with artificial intelligence (AI) capable of distinguishing between cobra and viper venom.

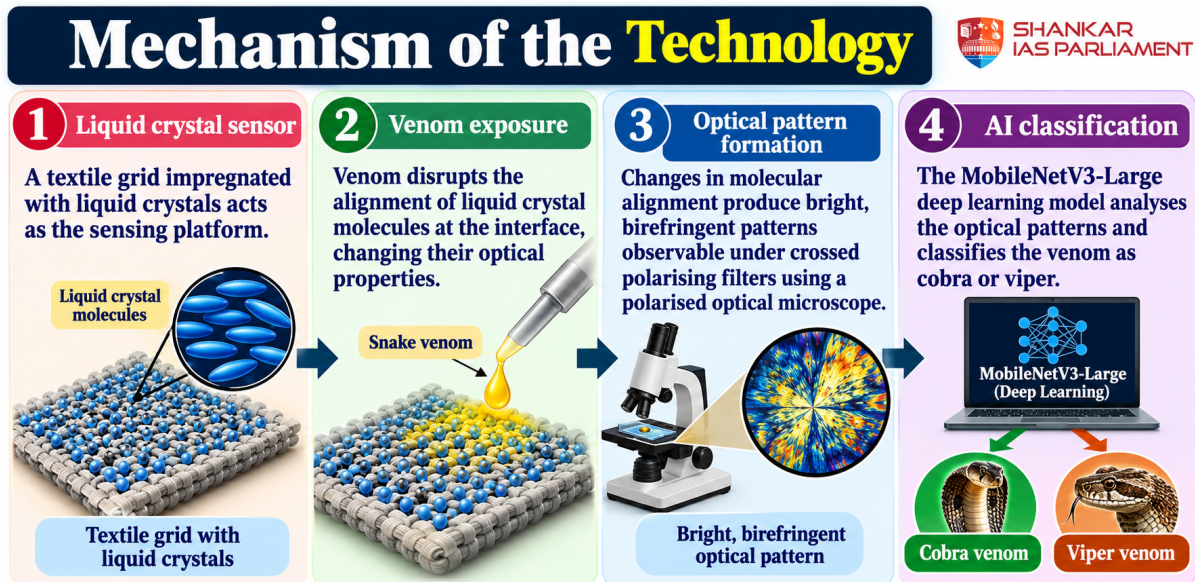


- The system achieved a classification accuracy of 95% with an optimal sensing time of four minutes.
- The study demonstrates a promising rapid diagnostic approach; however, additional validation is necessary prior to clinical implementation.

Potential advantages

- **Rapid identification** - It provides a classification result in approximately four minutes under the reported experimental conditions.
- **Cost-effectiveness** - It utilizes a relatively simple sensing mechanism, reducing overall operational costs.

- **No requirement for venom-specific antibodies** - It relies on changes in liquid crystal alignment instead of specific antigen-antibody binding.
- **AI-assisted analysis** - It detects optical texture patterns that are challenging to distinguish through visual inspection alone.
- **Potential clinical relevance** - It could support healthcare professionals in making more informed decisions regarding snakebite treatment.



Snakebite as a Public Health Concern

- Snakebite represents a significant public health concern, especially within rural and agricultural communities.
- Delayed access to treatment and challenges in identifying the snake species involved may complicate clinical management.
- The study reports approximately 4,500 to 7,000 snakebites annually in Iran; this figure is distinct from the snakebite burden reported in India.
- **Type of Antivenom**

Type	Description
Monovalent antivenom	Directed against the venom of a particular snake species or type
Polyvalent antivenom	Designed to neutralise venoms from multiple specified snake species

- Accurate identification of the snake species may facilitate the selection of the most appropriate treatment.
- Polyvalent antivenoms are commonly administered in cases where the responsible snake species cannot be reliably identified.
- Administration of antivenoms may result in adverse effects, such as allergic reactions and serum sickness.

Conventional Methods vs. Liquid Crystal-AI Sensor

Parameter	Conventional diagnostic approaches	Liquid crystal-AI approach
Principle	May use immunochemical methods or clinical assessment	Venom-induced changes in liquid crystal alignment
Signal	Biochemical reaction or clinical indicators	Optical patterns
Analysis	Laboratory testing and/or clinical interpretation	Deep learning-based image classification
Reported time	Depends on the method	4 minutes under study conditions
Main limitation	May require specialised equipment, time or reagents	Clinical performance and generalisability remain unvalidated

Limitations and Challenges

- **Limited scope** - Differentiates cobra and viper venom, but does not identify all venomous snake species.
- **Clinical validation** - Requires evaluation in real-world clinical settings.
- **Sensitivity issues** - Detection of low venom concentrations needs improvement.
- **Performance variability** - Variations in venom composition, sample quality, and environmental factors may affect results.
- **Diagnostic reliability** - Study accuracy may not directly translate to routine clinical practice.
- **Implementation barriers** - Cost, equipment requirements, training, and integration into healthcare systems remain challenges.

Key Scientific Concepts

- **Liquid crystals** - Materials exhibiting properties that are intermediate between conventional liquids and crystalline solids.
- **Birefringence** - A property of materials in which light experiences different refractive indices depending on its polarization and direction.
- **Polarised optical microscopy** - A technique for observing optical properties and structural changes in materials.
- **Deep learning** - A branch of machine learning employing multilayered neural networks to identify patterns in data.
- **MobileNetV3-Large** - A convolutional neural network architecture optimized for efficient visual recognition tasks.

Reference

[TOI | AI-Based Liquid Crystal Sensor for Snake Venom Detection](#)