EXPERT SYSTEM

ARTIFICIAL INTELLIGENCE

What is Expert System?

Expert system is a computer program designed to simulate the decision-making ability of a human expert in a specific domain. It uses knowledge and inference to solve complex problems.

Why Expert System

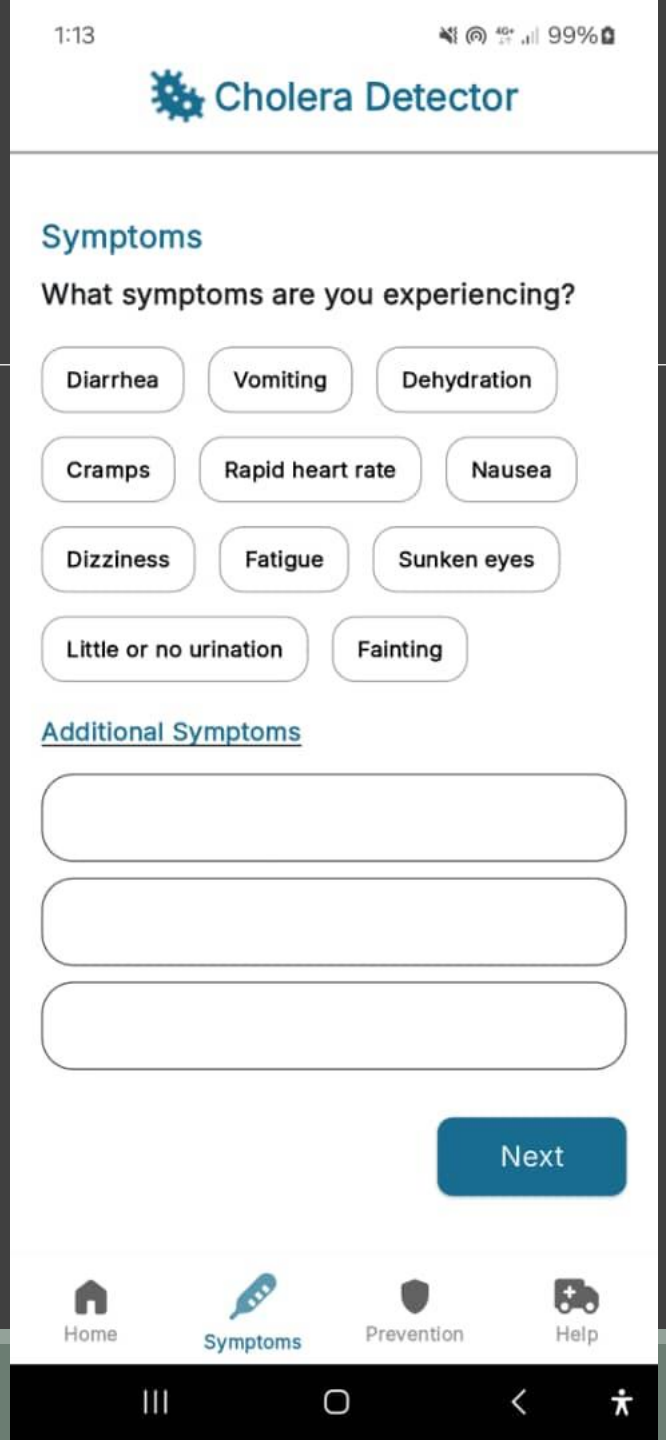
1. To provide expert-level solutions in specialized fields.
2. To assist professionals in decision-making.
3. To reduce reliance on human experts for repetitive tasks.
4. Real-World Examples: Medical Diagnosis: MYCIN (for bacterial infections).
5. Industrial Automation: Process control in manufacturing.
6. Business: Fraud detection and loan approval systems.

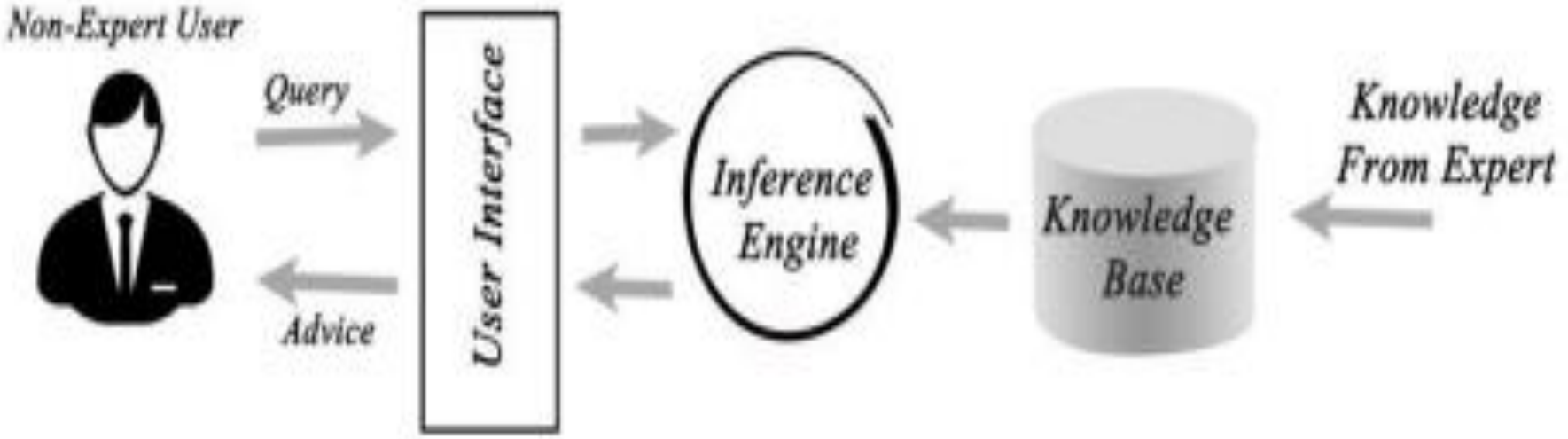
Characteristics of Expert System

1. High Performance: Works efficiently and consistently without fatigue.
2. Domain-Specific Knowledge: Limited to a particular field of expertise.
3. Rule-Based Reasoning: Uses predefined rules to derive conclusions.
4. Self-Learning Capability: Some systems can improve through machine learning.
5. Explanation Facility: Justifies its conclusions by explaining reasoning steps.

Components of Expert System

1. Knowledge Base: stores domain-specific facts and heuristics (rules of thumb). Can be structured as rules, semantic networks, or frames.
2. Inference Engine: processes knowledge to draw conclusions. Uses logical rules for reasoning (forward or backward chaining).
3. User Interface: allows users to input queries and receive recommendations.
4. Explanation Facility: provides insights into how the system reached a decision.


1:13
99%
Cholera Detector
Symptoms
What symptoms are you experiencing?
Diarrhea
Vomiting
Dehydration
Cramps
Rapid heart rate
Nausea
Dizziness
Fatigue
Sunken eyes
Little or no urination
Fainting
Additional Symptoms
Next
Home
Symptoms
Prevention
Help


Non-Expert User
Query
Advice
User Interface
Inference Engine
Knowledge Base
Knowledge From Expert

Types of Expert systems

1. Rule-Based Expert Systems: Uses IF-THEN rules (e.g., MYCIN for medical diagnosis).
2. Frame-Based Expert Systems: Uses structured knowledge representation (e.g., car troubleshooting).
3. Fuzzy Expert Systems: Handles uncertainty using fuzzy logic (e.g., air conditioning control).
4. Neural Expert Systems: Combines expert rules with neural networks (e.g., image recognition).
5. Hybrid Expert Systems: Merges different approaches for better accuracy (e.g., financial risk analysis).

Knowledge Representation in Expert Systems

1. Production Rules: IF-THEN rules to represent knowledge.
2. Semantic Networks: Graph-based structures linking related concepts.
3. Frames: Data structures with slots for attributes and values.
4. Logic-Based Representation: Uses propositional and first-order logic.
5. Image: A decision tree demonstrating IF-THEN rules.

Inference Mechanism in Expert Systems

1. Forward Chaining: Data-driven reasoning (starts with facts and applies rules to reach a conclusion).
2. Backward Chaining: Goal-driven reasoning (starts with a hypothesis and works backward to verify facts).
3. Hybrid Approach: Uses both forward and backward chaining for complex decision-making.

Development of Expert Systems

- **Problem Identification**: Define the domain and objectives.
- **Knowledge Acquisition**: Gather data from human experts, databases, and literature.
- **Knowledge Representation**: Structure information using rules, frames, or logic.
- **System Implementation**: Develop the system using AI tools and programming languages.
- **Testing and Validation**: Evaluate accuracy and effectiveness.
- **Deployment & Maintenance**: Ensure updates and improvements over time.

Applications of Expert Systems

1. Healthcare: Diagnosis and treatment recommendations (e.g., IBM Watson Health).
2. Finance: Credit risk assessment and fraud detection (e.g., Expert Financial Advisor).
3. Engineering: Equipment failure prediction (e.g., power plant maintenance).
4. Agriculture: Crop disease detection and soil management.

Limitations and Challenges

1. Knowledge Acquisition Bottleneck: Difficult to extract expert knowledge.
2. Handling Incomplete Data: Struggles with uncertainty.
3. Limited Common Sense Reasoning: Lacks general human intuition.
4. Complexity & Maintenance: Requires frequent updates.
5. Cost of Development: Expensive to build and maintain.

Future of Expert Systems

- Integration with Machine Learning: Improved self-learning capabilities.
- Cloud-Based Expert Systems: Greater accessibility and scalability.
- Explainable AI (XAI): Enhancing trust by making AI decisions transparent.
- Integration with IoT: Real-time expert decision-making in connected devices.