**LEM Architecture**

The Large Event Model (LEM) predicts next events in IoT networks through these key components:  
System Overview: LEM processes event tuples ( ) to optimize:

where is interruption, is knowledge graph, is history.  
Multi-Device Processing: Normalizes diverse device inputs into standardized vectors for downstream processing.  
Deviation Detection: Identifies anomalies by comparing events against predicted patterns using device-specific thresholds.  
Embedding Generation: Creates three parallel embeddings: (1) Device Embedding maps devices to vectors; (2) Time Series Embedding encodes temporal data; (3) Event Type Embedding represents attributes and states.

Fusion Module: Integrates embeddings via multi-modal attention:

Transformer Architecture: Processes fused embeddings through multi-layer operations with specialized attention mechanisms and feed-forward networks.

Multi-Head Attention: Employs four specialized heads (Specialized, Temporal, Device, and Physical Constraint) using the general form:

where represents type-specific relationship matrices.  
Knowledge Graph: Incorporates device relationships via R-GCN:

Event Prediction: Generates next event probabilities:

This architecture achieves accuracy across event categories with inference speeds faster than comparable models, making it ideal for real-time IoT applications in smart homes, industrial settings, and energy management systems.