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(57) Abstract :

A multi-modal Edge intelligence system for transformer failure prognostics, comprises of a plurality of sensors integrated in a housing 101 on transformer bushings 102 for monitoring mechanical, thermal, and electromagnetic parameters, a physics-informed neural network (PINN) 106 to combine finite element analysis simulations and Long Short-Term Memory layers to generate self-updating fragility surfaces responsive to storm intensity vectors, an autonomous energy harvesting arrangement 107 employing a Bismuth telluride (Bi₂Te₃) based superlattice unit to convert surface heat gradients into continuous power, a closed loop prevention module implemented through Edge computing for detecting anomalies and triggering automated countermeasures, a Blockchain value capture module 108 to mint ERC-1155 non-fungible tokens documenting preventive actions and avoided failures, and a processing module 111 with nonvolatile memory 110 to execute embedded network 106.

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