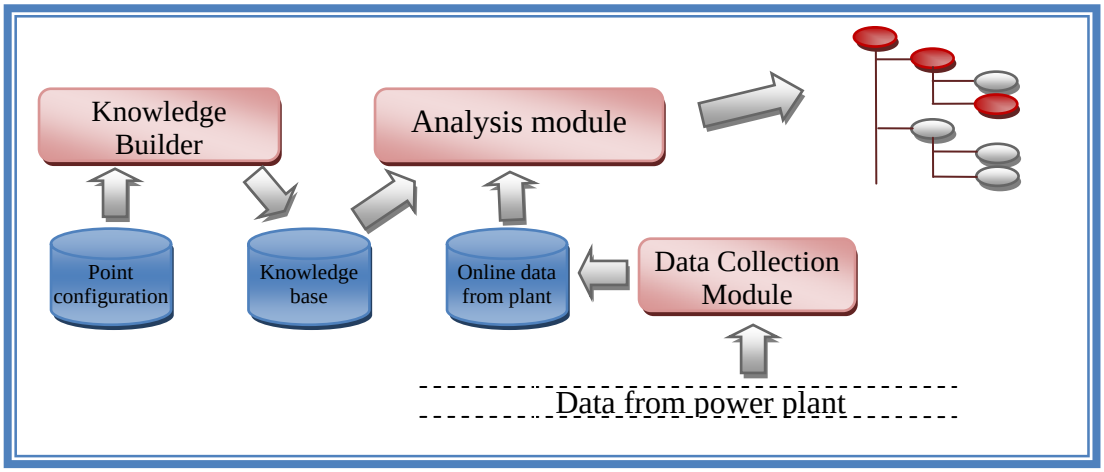
Expert System for Alarm Guidance

Expert system provides a way to capture the knowledge of experts in certain domain and use it for providing guidance for a novice in the domain. This system was developed for guiding operators to resolve alarms/faults with a tree-like display of causes (faults and probable causes). The system contains a real-time scanning system and an alarm analysis system with backward reasoning.

Phase 1: Using Proprietary framework (1996 - 1997)

This system was developed for thermal power plants for analyzing the alarms in plant using backward reasoning. With the help of this system, the operator can find out possible reasons for the generated alarms and can take necessary action at the earliest to resolve the issues

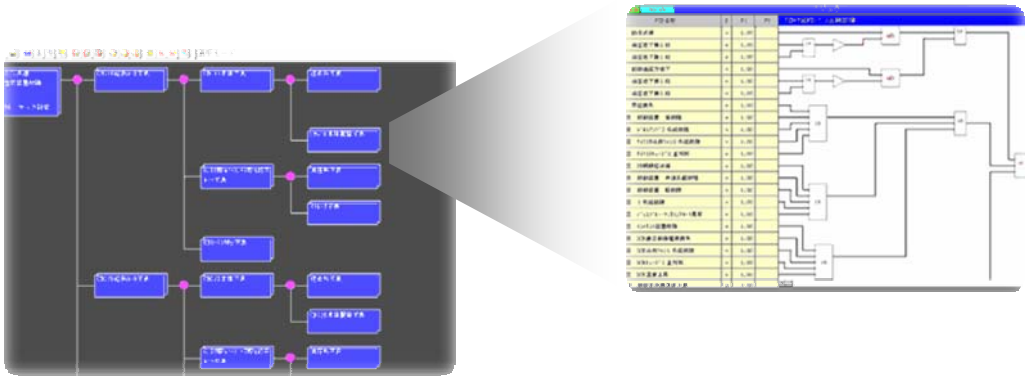
Architecture



The system has a real-time **analysis module** for evaluation of the causes for the alarms in a power plant using a knowledge base. The major portion of the knowledge base is prepared by an expert in power domain, using an **offline builder**. There will be few additions to the knowledge base during runtime, with operator assistance, based on specific operating scenarios. Thus the system will be continuously tuned for plant conditions.

The knowledge base contains problems to analyze, points from power plants to monitor and criteria/rules in tree form for finding the cause. Offline storage was done in text format and will be converted to appropriate binary form for versions of online in different operating systems.

Rules are defined in a two-level graphical editor. The first level editor is used for defining problem in elementary expression component as shown below. The second level editor is used to build the relationship in tree form.

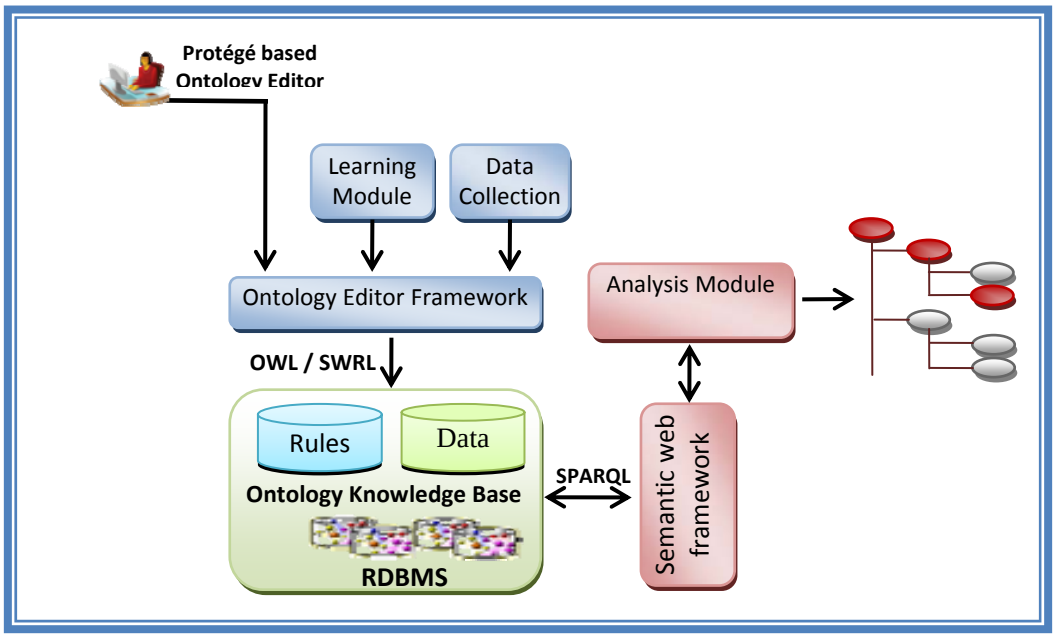


Whenever an alarm occurs, the analysis module uses the information from knowledge base and the real time plant data received from the **Data Collection Module** to infer the actual cause(s) of the alarm. The output is shown in a tree form graphically. The root node represents the alarm in analysis and the leaf nodes represent all the possible causes at the lowest level. Different color coding is used to help the operator to infer the severity of the problem. A sample screen of online is shown below.

Phase 2: Adapting W3C Semantic web standard (2008 - Ongoing)

NeST is in the process of revamping the existing alarm diagnostic system using Ontology and Semantic search. The knowledge base and the rules are being converted from the proprietary text file format to OWL and SWRL. Protégé based ontology editor is used for building the knowledge base in place of the proprietary editor.

Architecture



The knowledge base is built using **Protégé based Ontology editor**. The classes like major alarms to watch, the low-level alarms and the relation between them are captured in the knowledge base using OWL and SWRL.

The **Learning Module** is responsible for updating the knowledge base during runtime, with the assistance of the operator. The **Data Collection** module collects the dynamic data from plant and updates it to the knowledge base. The online learning and the data collection modules also uses the Ontology Editor Framework to update the data to the knowledge base.

A **semantic web framework module** is provided for the semantic search facility. The online **Analysis Module** is responsible for analyzing alarms and for providing the guidance. Whenever an alarm occurs, the analysis module queries the knowledge base using the semantic web framework module.

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