A Framework for Model-Based Diagnostic Expert Systems

March, 1996

Yusuf Wilajati Purna

Diagnosis is a significant applications of *Artificial Intelligence* or *Expert Systems* technology in particular. It is also a hard task since it is required a great deal of various information to do the task. This thesis describes a piece of research aimed at providing a framework for diagnostic expert systems, considering knowledge and strategies that are useful for diagnosis. The proposed framework divides the task of diagnosis into three subtasks, namely *Hypothesis Generation*, *Hypothesis Testing*, and *Hypothesis Classification*, and classifies information required to diagnose faults into three classes: the *Domain Model*, *Additional Domain Knowledge*, and *Diagnostic Strategy*.

In generating fault hypotheses, the framework makes use the *Device Model*, *Process Model*, and *Topological Relative Position* of the domain model of the device to be diagnosed as well as the *Heuristics* and *Native Physics* of the additional domain knowledge of the device. It also applies the *Qualitative Value Propagation*, *Direct Path of Causality*, and *Structural Fault Localization* as strategies for diagnosing faults. To test generated fault hypotheses, the framework exploits a method identifying types of inconsistent fault hypotheses into three types: *Pseudo Fault Hypotheses*, *Contradicting Fault Hypotheses*, and *Candidate Faults*, and pruning them based on those three types. In the final task, the framework classifies fault hypotheses into different ranked orders based on *Component Observability*, *Component Durability*, and *Component Failure Rates* criteria.

The framework has been implemented in a computer program called MODEST{**MO** del-based **D**iagnostic **E**xpert **S**ys**T**em} using SICStus Prolog runing on a SPARC station and tested in diagnosing possible faults in the domain of refrigeration plants with promising results.