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Fault Tree Analysis approach for Analog Circuit

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ABSTRACT: Due to the wide range of applications of electronic circuits in the recent years, the fault diagnosis in electronic circuits is a foremost problem. The main purpose of the fault diagnosis technique is isolating the faults present in the electronic circuits and also, detecting the fault which affects the safety and performance of the system. For various real-time applications of fault diagnosis, literature presents several techniques for detecting the faults in electronic circuits.

KEY WORDS: Fault Diagnosis ,Fault tree analysis, Regulated power supply.

I. I.INTRODUCTION

This research is about the fault diagnosis in electronic circuits. Due to the wide range of applications of electronic circuits in the recent years, the fault diagnosis in electronic circuits is a foremost problem.
Fault diagnosis isolates the source(s) of a system malfunction, by collecting and analyzing information on system status using measurements, tests, and other information sources (e.g., observed symptoms).
Often, it performed by a human diagnostician, and it is an important function at all stages of the product lifecycle, but particularly during manufacture and field maintenance. Over the last three decades, fault diagnosis is major concept to solving the problems in electronics circuitry .
In this paper we are discus about the **FAULT TREE ANALYSIS OF ELECTRONICS CIRCUITRY** with respect to one example of **"fault finding in regulated power supply ".**

II. LITERATURE SURVEY

The literature review of journal papers was done : On the concepts of fault diagnosis in electronics circuits their various papers available . For this paper we refer the "Fault Diagnosis of Electronic Systems " a review paper by *William G. Fenton, Member, IEEE, T. M. McGinnity, Member, IEEE, and Liam P. Maguire.*
After referring to this paper we come to result that there are some basic methods to finding the fault in the electronic circuits they are…

Types of methods

A. Case based

B. Rule based

C. Model based

A. CASE BASED

Case-based systems depend on past diagnostic experiences to perform new diagnoses. In practice, CB has proved to be effective in real-world circuit diagnosis applications . A human technician can apply troubleshooting techniques learned on one product to a different product, by extracting general purpose rules or procedures from specific experiences. In the case base is divided into generic and specific knowledge
However, the generic case base is defined by domain experts and is not incremental.

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B. RULE BASED

Rule-based diagnostic systems represent the experience of skilled diagnosticians in the form of rules which generally take the form "IF symptom(s) THEN fault(s)." Representing the knowledge for a particular problem domain, may require hundreds, or even thousands of rules. Rule-based inference involves taking information about the problem domain, and invoking rules which match this information. This generates new data which is added to the problem information. This process is repeated iteratively until a solution to the problem is found. Most intelligent diagnostic programs implemented in the 1970s and early 1980s were of this form.

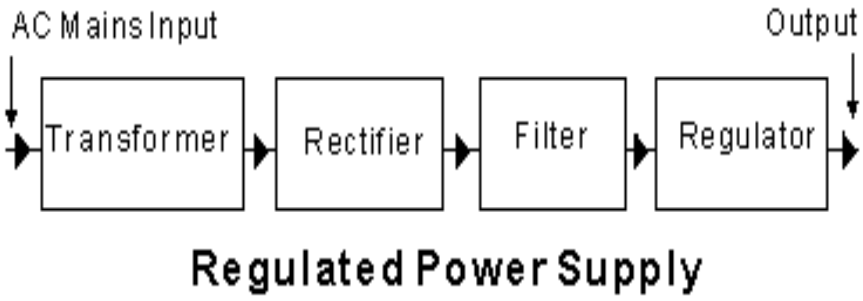
C. MODEL BASED

Over the last 15 years, models have superseded rule-based techniques, as one of the premier research directions for intelligent systems diagnosis. A model is an approximate representation of the actual system being diagnosed. Model-based diagnosis involvesusing the model to predict faults using observations and information from the real device or system. Models are often used in a hierarchical fashion, that is initial diagnosis is performed to a subunit level using a high level model and then a more detailed model of the subunit is used to diagnose to the next level and so on. Various types of approaches have been used including fault models, structural models, behavioral models, and diagnostic inference models. The following sections discuss these various approaches, and their associated inference mechanisms.

III. PROPOSE METHODOLOGY

for explaning the propose methodology we take a example of regulated power supply .

A. Block diagram of regulated power supply



B. Working

- The regulated DC power defines a DC power supply which maintains the DC voltage constant irrespective of AC input fluctuations in load resistance values.
- The block diagram of a regulated DC power supply is shown in above figure.
- It consists of rectifier, filter and voltage regulator circuits. The load may be connected across the voltage regulator. Commonly the bridge rectifier is used in regulated power supply. Its function is to convert the AC mains voltage to the rectified DC voltage.
- The voltage contains small amount of ripple the pulsating voltage is passed through the filter circuit. Its function is to bypass the filter.
- The pulsating opposes the AC fluctuations. This voltage is applied to the voltage regulator. Its function is to maintain the output DC voltage constant irrespective of fluctuations in AC mains voltage and variations in currents load.
- Thus, the regulated power supply gives the stable DC voltage across the load .

For finding fault in the regulated power supply we propose the following methodology which is based on rule based method that is **"FAULT TREE ANALYSIS "**.

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- **What is fault tree analysis?**

Fault tree analysis (FTA) was originally developed in 1962 at Bell Laboratories by H.A. Watson, under a U.S. Air Force Ballistics Systems Division contract to evaluate the Minuteman I Intercontinental Ballistic Missile (ICBM) Launch Control System.

Fault tree analysis (FTA) is a top-down, deductive failure analysis in which an undesired state of a system is analyzed using Boolean logic to combine a series of lower-level events. This analysis method is mainly used in safet engineering and reliability engineering to understand how systems can fail, to identify the best ways to reduce risk and to determine (or get a feeling for) event rates of a safety accident or a particular system level (functional) failure.

FTA is also used in software engineering for debugging purposes and is closely related to cause-elimination technique used to detect bugs. minimize and optimize resources.

The FTA can be used as a design tool that helps to create (output / lower level) requirements..

Expiation of fault tree analysis

- By considering the next fault tree diagram we can express the our propose methodology for expressing it as we mention we take a example of regulated power supply .
- For that we consider the micro level block diagram of regulated power supply .The main blocks in the micro level block diagram are as follows
  1.Fuse plate
  2.Transformer
  3.Rectifier
  4.Filter
  5.voltage regulator
- In the tree diagram main block used name as decision making block that test or check the conditions and give the output in the form of yes/no, proper/in proper, ok/not ok , working /not working etc.
- Description
  - Firstly we start the analysis then test the main source of the AC input properly if that okay then go forward .
  - Now, test the fuse plate if the fuse ratting is okay then go forward else replace the fuse plate.
  - Now, test transformer it's primary & secondary windings voltage ratting if okay then go forward else replace the transformer
  - Now, test the working of rectifier if working is okay then go forward else replace the rectifier.
  - Now check the behaviour of filter & then regulator if okay then go forward.

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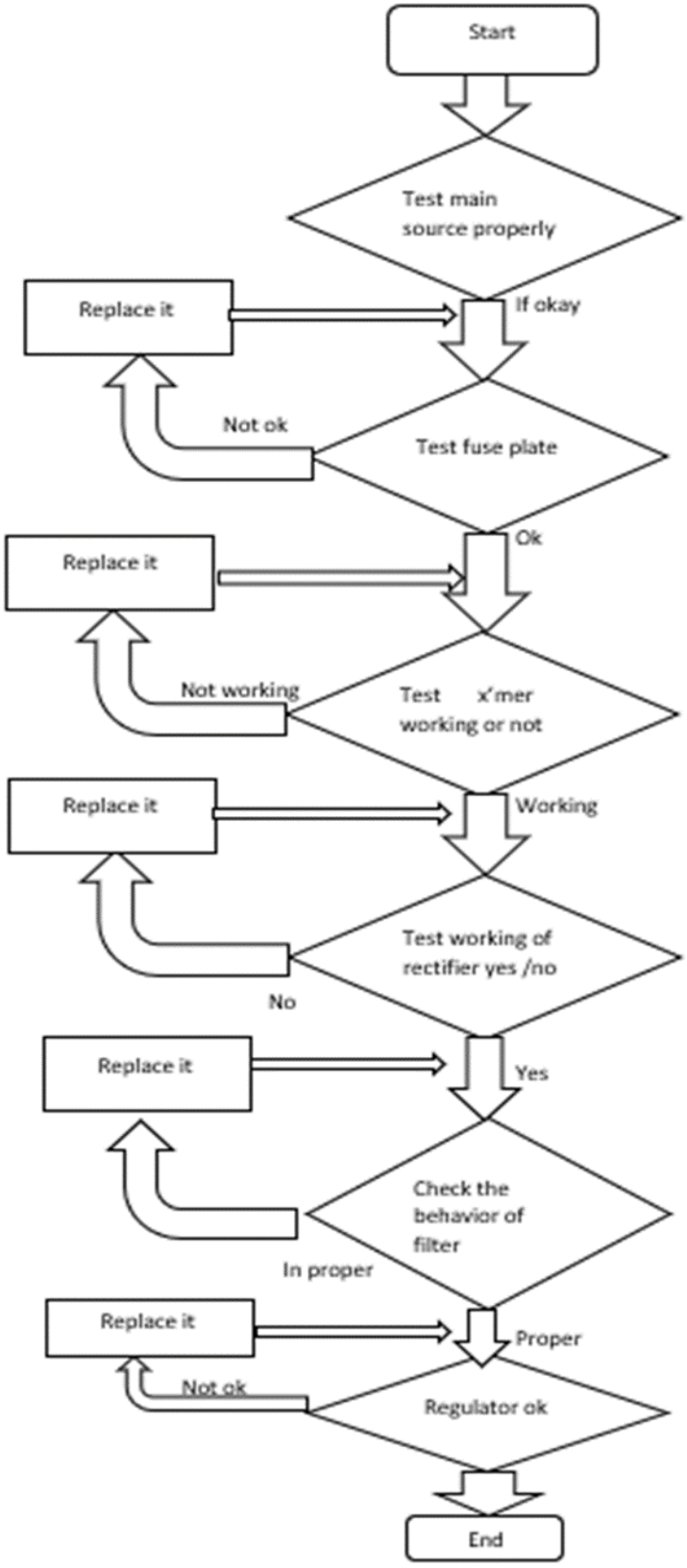

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IV. FUTURE SCOPE

In this way we can also find the fault at component level ex. Cable Now we are discus about the fault in the cable.There are only two probable faults in the cable that is cable short or cable open .In the case of bearing or ageing of the cable this only two cases is found .

Like this we can find the fault whiter it is voltage regulator by using Zener diode ,or series regulator or by using IC723.Hence this is one aspect of FTA, like this we can find the fault in the particular block as well as at the component level

For example if we consider an any communication device / electronic device. (we take an example of radio receiver) The regulated power supply is a one block in the radio receiver .we can find out the fault. in the regulated power supply by using fault tree analysis as mention in above description . The whole device can be divided in to many small blocks like regulated power supply and processing circuit etc. As mention in the FTA, the fault in the RPS is solved . In the same way we can find out the fault in the entire device . With the help of fault tree analysis we can prepare the algorithm & then software can be develop for analysis purpose .

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