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AC MOTOR FAULT ANALYSER BY CHARACTERISTIC ANALYSIS

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Abstract - *A big challenge faced by major industries now a day is motor testing. At present motors are tested only after they are assembled with other circuit components. The major drawback is that, if any fault is detected in the motor after the assembly stage, the whole system has to be dismantled. In order to overcome the difficulty, we have come up with this new system with which the motor can be tested at its place which in turn gives a detailed analysis of the type of the fault using Variable frequency drive for Induction motor and Servo drives for servo motors. In this system, recoverable faults are analyzed using the characteristic waveforms of the motor, which is an easy method compared to other methods of fault analysis .The Waveform is Displayed in HMI.*

Key Words: **Servodrive, HMI, Variable Frequency Drive**

1. INTRODUCTION

Motor fault is a major drawback in Electrical Machines. Hence fault analysis has become mandatory in all industries working with electrical motors. Generally a fault analyser is a stationary machine which is used in industries to test the motor for various faults. Motors in industries are tested finally after the assembly stage. This has several disadvantages as a fully assembled machine contains several number and kinds of motors being used together. So if a fault is detected by the fault analyser at that stage, it is difficult to identify which motor caused the fault which results in dismantling of the motor, identifying the faulty motor and then sending it for analysis, which in turn is a very big process. In order to make this process simple, it has become necessary to build a portable fault analyser with which a motor can be tested from its place and it need not be carried all the way to the fault analyser. In this portable fault analyser, characteristic analysis method is used. Using drives, PLC and HMI the characteristic waveforms are displayed and then analysed for general industrial motor faults like over current fault, over voltage fault, thermal overload, positional error etc..

2. BLOCK DIAGRAM

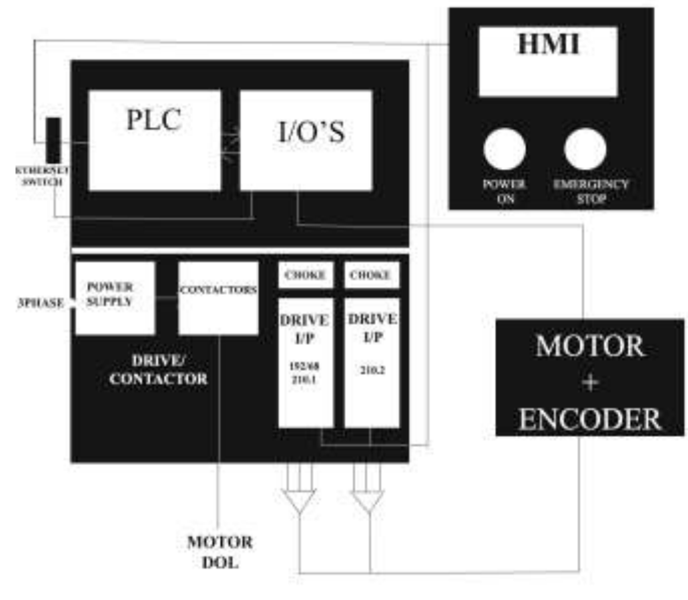

FIG 1 BLOCK DIAGRAM

2.1 MOTOR

An **AC motor** is an electric motor driven by an alternating current (AC). The AC motor commonly consists of two basic parts, an outside stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft producing a second rotating magnetic field. The rotor magnetic field may be produced by permanent magnets, reluctance saliency, or DC or AC electrical windings.

2.2 SERVOMOTOR

Servo motors are electric devices that are used for linear or rotational movements in electrical machines. Servos are found in many places, from toys to home electronics to cars and airplanes. Servo motors are self-contained. A remote-controlled model car or airplane or helicopter, will have many servo motors working inside them to constitute a fully functional model. The speed regulation of a fuel-powered car is done by servomotors by rotating a shaft connected to the engine throttle. Knowingly or unknowingly we use servomotors every day.

Servomotors work on the principle of Pulse Width Modulation(PWM), which means that its angle of rotation is controlled by the duration of applied pulse to its control pins. Servomotor consist of a controller device, output sensor and a feedback system. Since there is a feedback system, it is considered to be a closed loop system with a positive feedback to control the motion and final position.

2.3 INDUCTION MOTOR

An **induction motor** is an **asynchronous machine** in which torque is produced when there is availability of electric current in the rotor which is obtained by electromagnetic induction from the magnetic field of the stator winding. An induction motor can therefore be made without electrical connections to the rotor. An induction motor is of two types- wound rotor and squirrel-cage rotor type.

Three-phase squirrel-cage induction motors are self starting and therefore widely used as industrial drives. Reliability and cost wise economic are the notable advantages in squirrel cage Induction motors. Single-phase induction motors are used extensively for smaller loads, such as household appliances like fans. Induction motors are increasingly being used with variable-frequency drives (VFDs) in variable-speed service. VFDs offer high intelligence, providing variety of data for characteristic analysis and fault detections. Squirrel cage induction motors have wide range of applications in both fixed-speed and variable-frequency drives (VFD).

3. DRIVES

We Are Using Two Types of Drive

- Variable Frequency Drive
- Servo Drive

3.1 VARIABLE FREQUENCY DRIVE

A variable-frequency drive (VFD) is also known as adjustable frequency drive or variable-voltage/variable-frequency (VVVF) drive, variable speed drive, AC drive, micro drive or inverter drive. It is used in electro-mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage. VFDs are high intelligent drives used in smaller and larger applications An Industrial work could be made 25% more efficient when VFDs are used. Using VFDs we not only control the torque and speed parameter, but also can get variety of details about the Ac motor connected to it. VFDs also play a vital role in fault detection and analysis.

FIG 2 VFD

3.2 SERVODRIVE

Power electric servomechanisms are performed using servo drives. It is a special electronic amplifier used to drive a servomotor and control its variable parameters. A servo drive monitors the feedback signal from the servomechanism and continually adjusts for deviation from expected behaviour.

Servo drives are used in industrial automation, CNC machining and in robotics where there is a necessity of servo motors. Their main advantage is the addition of feedback control which is not available in normal DC motor drives and AC motor drives. Generally encoders provide positive feedback to the servo drives.

FIG 3 SERVODRIVE

4. PROGRAMMABLE LOGIC CONTROLLER

A **programmable logic controller** (**PLC**) or **programmable controller** is an industrial digital computer which has a CPU and I/O modules which has been adapted for the control of manufacturing processes, robotic devices, or any activity that requires high reliability. It makes the process of fault diagnosis easy

Features and Benefits

Machine builders and end users can take advantage of the cost-saving features of these controllers:

- Support for Integrated Motion on Ether Net/IP
- Support for Device Level Ring (DLR) network topologies
- Built-in energy storage eliminates the need for lithium batteries
- Support reuse of existing 1769 I/O

- Removable 1GB secure digital (SD) card improves data integrity
- Memory options up to 1MB
- Higher resolution analog capability supports thermocouple and RTD inputs
- Support for Kinematics eliminates the need for additional robot controllers and software
- Open socket capability allows support for Modbus TCP as well as devices such as printers, barcode readers and servers

Using a PLC the tags of the HMI can be connected using the ladder diagram and can be controlled from the display of the HMI. The PLC in co-ordination with the drives helps in the analysis of fault using the characteristic waveforms from the HMI. Various faults in an AC motor are analysed , detected and displayed on the HMI screen. Thus the process of fault analysis is made easier in industries compared to other methods of analysis.

Integrated Motion on Ether Net/IP

The Compact Logix 5370 L2 controllers has improved performance and is cost-effective.

- Supports up to 4 axes of integrated motion.
- Together with the Kinetix 350, offers cost-effective, scalable motion solution

Network Capabilities

With dual Ethernet ports and an integrated Ethernet switch, these controllers now support Device Level Ring (DLR) network topologies, simplifying integration of components in your control system and reducing system cost.

FIG 4 PLC

5. HUMAN MACHINE INTERFACE

As the name says, Human-Machine Interface (HMI) is an interface used by an user to connect a person to a machine, system, or device. While the term can technically be applied to any screen that allows a user to interact with a device, HMI is most commonly used in industrial machines to avoid direct contact of a person with a heavy machinery. HMI is also called Man-Machine Interface (MMI), Operator Interface Terminal (OIT), Local Operator Interface (LOI), or Operator Terminal (OT). HMI and Graphical User Interface (GUI) are similar but not synonymous.Generally HMIs can be used to:

- Display data Visually
- Track trends, and tags

Using tags, can control the entire machine

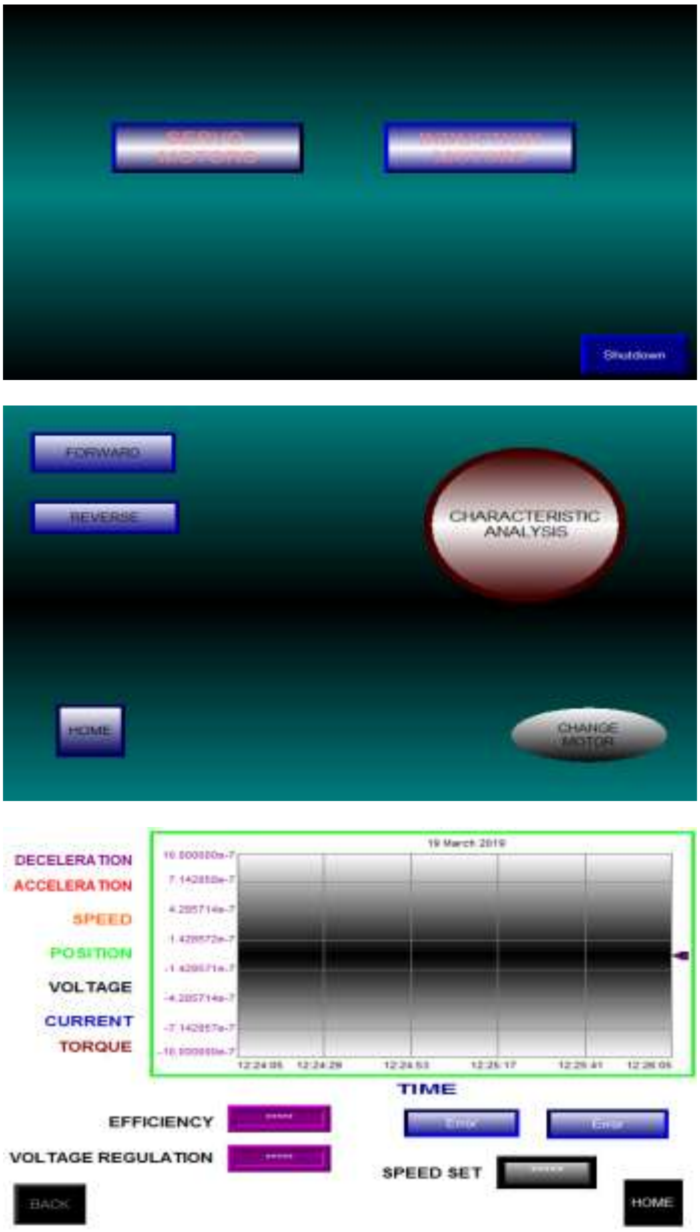

FIG 5 HMI DESIGN

6. SIMULATION RESULTS

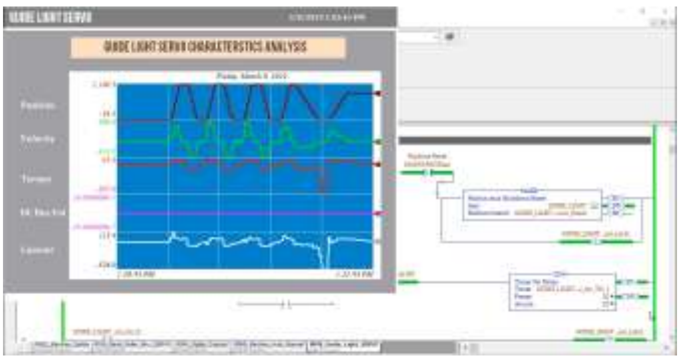

FIG 6 SERVO CHARACTERISTICS

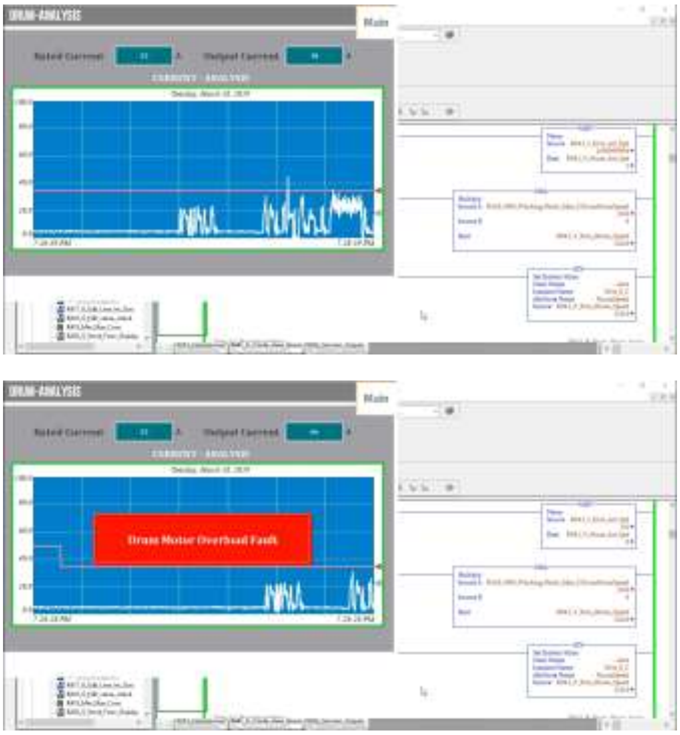

FIG 7 INDUCTION CHARACTERISTICS

7. CONCLUSION

Thus the Induction And Servomotor is tested and fault in the motors is detected using the characteristic graph of the motor in the HMI display.This prevents the Motor failure in the industries and also it is used to test the condition of motor

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