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RTOS based Online Condition Monitoring and Diagnosis of Electrical Equipment

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Abstract*—In an electrical system if the maintenance process carried over in scheduled manner there is a chance that would leads to unexpected failure before our next scheduled maintenance break. RTOS based Online condition monitoring techniques for electrical equipment mainly includes system status, system performance, system recovery and automatic diagnosis. If the electrical systems are more complex, its better to split into number of tasks. These tasks would have different priorities and timing deadline. By using priority scheduling algorithm the various tasks were managed. With the help of C language, the program has been written to assign the task priorities, timing deadline to monitor the tasks, and also recovery actions should be carried over if any fault occurs. This program has been flashed at ARM7 processor and based upon that the entire system works. This emulation supports online condition monitoring to monitor and diagnosis of electrical equipment in real time.

***Keywords*— RTOS, ARM7 processor, Matlab-Simulink, LPC2148 kit,Priority scheduling algorithm.**

I. INTRODUCTION

After the fault occurrence only in reactive maintenance the repairs were done. Reactive maintenance focuses on restoring the equipment to its normal operating condition. avoided. The capacitance-to-ground also indicates the winding cleanliness. Raise in CTG values indicates that the motor needs to be cleaned. In AC motors with the help of phase-to-phase inductance readings the condition of the stator windings can be monitored, Detection of phase-to-phase and coil-to-coil current leakage paths, poor or incorrect network are possible [1]. If the possibility of fault occurring condition is known during scheduled maintenance break the recovery actions can be carried over easily. This type of maintenance is known as By replacing or repairing faulty parts the equipment which has fault would return to working condition. As the shutdowns happens during production the speed of shipping for spare parts costs much more than regular shipping. The maintenance staff is often forced to work overtime to repair machinery [7]. Software based condition monitoring is also known as CMMS which maintains a computer database of information about an organization's maintenance operation. With the help of this information the maintenance workers will do their jobs more effectively and it also helps the management to make informed decisions. This packages also gives the summaries of maintenance activities[5] .

The online monitoring system is employed with the help of this several transformers monitored simultaneously. By analyzing variations in the magnetic flux while rotating the rotor, eccentricity and rotor defects are identified. By analyzing the resistance-to-ground (RTG) measurement cleanliness and health of the insulation system identified. With the help of this, the insulation ages, cracks and small holes develop can be Planned Preventive Maintenance (PPM). If scheduled service visit carried over we can avoid any unscheduled breakdown and downtime. According to manufacturer's recommendation Planned maintenance is created for every item separately. Plans can be date-based, based on equipment running hours [6]. The disadvantages of preventive maintenance are the cost is more than breakdown maintenance, requires more workers, there will be the time interval for each and every maintenance in between that fault occurs entire system will be affected.

Electrical System if complex better to split into many no of tasks and each task need to execute specific interval of time and own order of execution. Round robin Scheduling algorithm is used to assign the time period for each and every tasks. As per the assigned time period all the task actions would be completed. The tasks can be managed by Interrupt or Polling method but it is not effective to manage too many tasks. [8].Round robin scheduling algorithm is priority free algorithm. To monitoring the Electrical equipments tasks its better, if there is the possibility to assign priority to tasks. So Priority scheduling algorithm was used in this paper.

II.PROPOSEDMETHODOLOGY

This project has four modules as shown in Fig 1. Those are Sensor Interface Unit, Monitoring Unit, Diagnosis Unit and Recovery Unit.

A. Modules used

a. Sensor interface unit

In this unit the different sensors can be connected with the electrical equipment, Sensor outputs are monitored and Linux Device Drivers used to read the data from sensor interfacing unit and transfer the data to Monitoring Unit.

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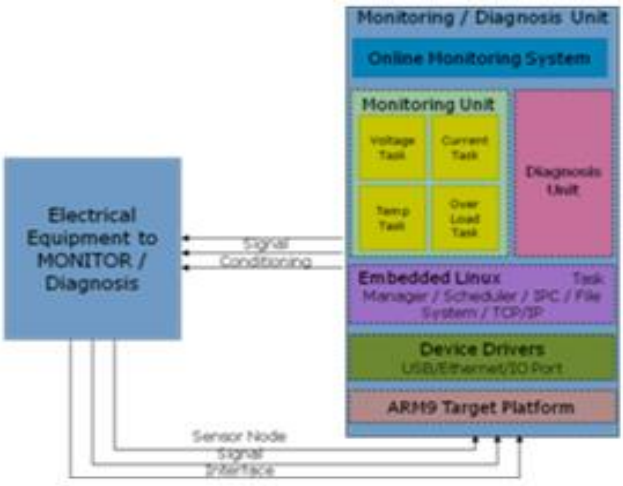

Fig. 1. Electrical System Testing Model

Device drivers read the data from sensors and it keeps it in buffer. The temperature, vibration, current, voltage, over load, speed of the electrical equipment sensed and the information gathered was given through the sensor interfacing unit to the monitoring unit.

b. Monitoring unit and diagnosis unit

Monitoring Unit Capture the data from Sensor interfacing Unit. Monitor Unit supports different tasks like temperature, voltage, current, vibration, overload, speed. Task priority, scheduling, and deadline are configured using Embedded Linux System Calls. Monitoring unit Capture the system information based on each task configuration and priority level.

Diagnosis unit read the data from monitor unit and executes the respective diagnosis operation as per the program flashed at the processor and Send Control Information to recovery unit. Each and every task would have different priorities and timing deadline.

Depending upon the priority assigned to the tasks, and the timing assigned to the tasks the tasks has been managed. The first priority would be given to the higher priority tasks, and then only the lower priority tasks would be concentrated. All those are controlled by the RTOS.

c. Recovery Unit

Recovery Unit reads the data from diagnosis unit and generates the appropriate signal conditioning to take action on system. The Linux Device Drivers used to write the data from recovery unit to the HW unit. Then Interface the Electrical Equipment with ARM7 based embedded processor unit. For each and every task the certain time period allocated to complete it. If exceeds, the indication passed by diagnosis unit to the recovery unit. In the recovery unit the recovery action carried over like within the allocated time interval the task would be completed.

B. Priority scheduling algorithm

The multitasking is possible by using scheduling algorithm. In the Round robin scheduling algorithm the task execution is done on a circular Oder, one after another. Even though some task have the high priority that won't be considered. To manage the tasks the priority scheduling algorithm was used in this paper. First the high priority tasks would run while others will wait for its turn.

The priority of the newly arrived process is compared with the process at Running state and if its priority is higher than the process which was at running state then the high priority process would goes to the Running state and low priority process goes to the Waiting state as shown in the Fig2.

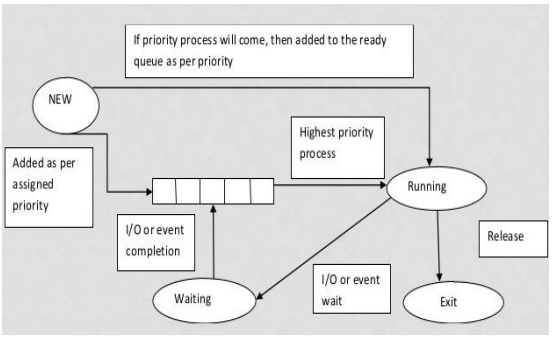

Fig.2.Pre-emptive scheduling algorithm flow chart

Letsconsider electrical equipment Vibration monitoring task is at running state, if the vibration is too high then this task would goes to the Waiting State and the Voltage monitoring task would goes to the running state.

III.RESULTANDANALYSIS

A. Software Implementation

In the proposed method the current, voltage, speed, temperature of electrical equipment monitored continuously with the help of the MATLAB simulink then the real time implementation carried over with the help of the LPC2148 board, temperature sensor, Vibration sensor, Voltage sensor, RTOS and C language

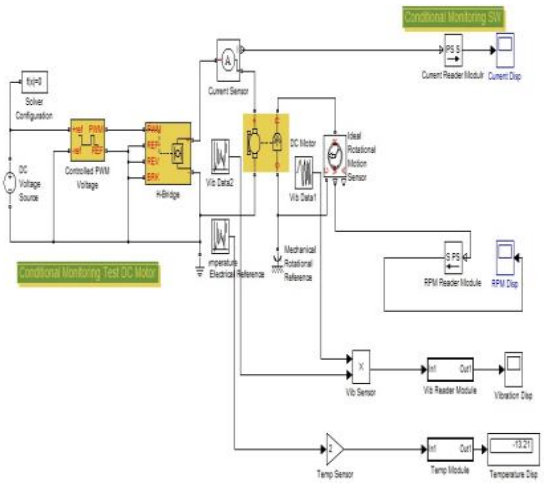

Fig.3Online cm system model using Matlab-Simulink

As shown in the Fig 3 from the power supply the signals would be given to PWM there the signal would be conditioned and then the signal would be given to the h-bridge there the signal would be allowed to send in bidirectional then with the help of the sensors the signals would be sensed and given to the monitoring unit. The current, speed, vibration, temperature of the electrical equipment monitored continuously with the help of the Simulink design.

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The temperature of the design sensed by the temperature sensor unit and it would be displayed in the temperature display unit. After the successful implementation of this MATLAB-SIMULINK model only the real time implementation carried over with the help of the LPC2148 kit.

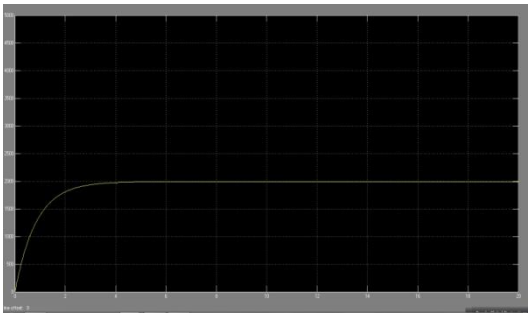

Fig.4. Rpm Display

The speed of the motor has been monitored and the information was passed to the RPM reader. With the help of RPM display unit we can view the speed of the motor .As shown in Fig 4.At the starting the speed is low for any motor so the signal seems increasing from low to high.

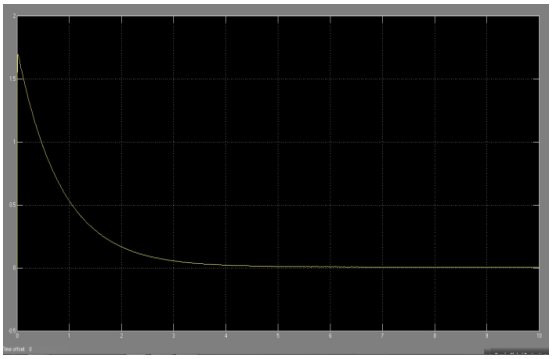

Fig.5. Current Display

The Current source of the motor monitored and displayed with the help of the Current display unit. As shown in the Fig5.For any motor at the starting the current would be given more, then only the stable state would be attained.

The Vibration of the motor monitored and displayed with help of the vibration display unit. For any motor, the vibration would not be stable all the time. As Shown in Fig 6 it will vary continuously.

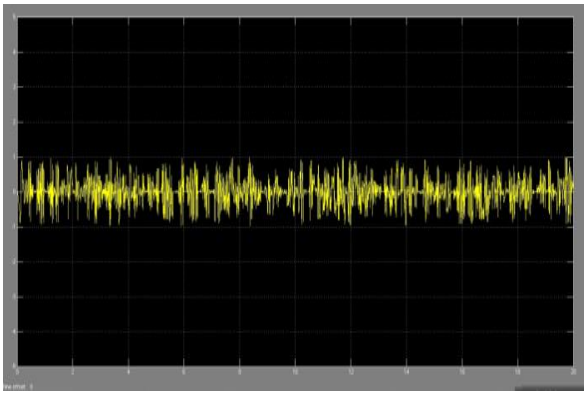

Fig.6. Vibration Display

B. Hardware Implementation

Fig7 shows the real time implementation result. The LPC2148 board has been used for the real time implementation.

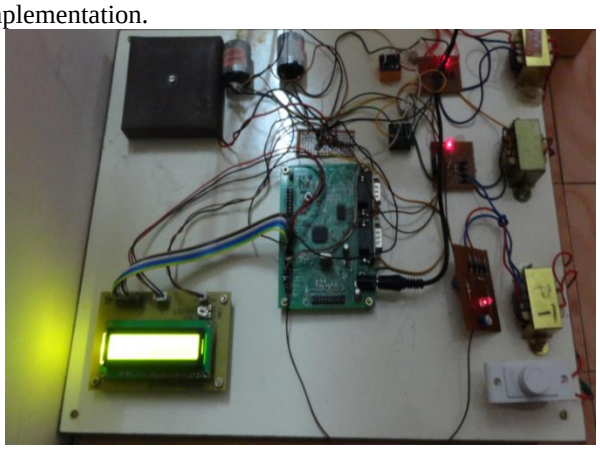

Fig.7. Real time implementation result

In this board UART, SPI, SSP all those devices are inbuilt these would provide high processing power. The vibration sensor uses piezo electric transducer concept which sense the vibration and send the information to the processor. The voltage sensor uses Potential transformer which has been used to control large value of voltage, FWBR which has been used for AC to DC conversion, voltage regulator which maintains the constant voltage level. The voltage sensor would complete its task and send the information to the processor. To sense the temperature LM35 has been used this sensed information would be passed to the processor. Depending upon the sensed information the actions has been carried over as programmed in the processor.

In the proposed method an electrical equipment temperature, vibration, voltage all those has been continuously monitored and the information has been passed to the processor. In the processor for each parameter monitored LOW, MEDIUM, HIGH conditions were programmed by the programmer. So depending upon the program written by the programmer an electrical equipment conditions displayed at the display unit, which has been interfaced with the LPC2148 board. While monitoring the tasks if fault occurs, the recovery actions which should be carried over that also have been flashed on the processor. Depending upon that the recovery actions carried over.

Similarly, the priority also has been assigned to the tasks and depending upon the priority allocated to the tasks it has been implemented. While sensing the temperature 70 degree Celsius was assigned as low temperature, 120 degree Celsius was assigned as Medium, 180 was assigned as High. If temperature is high means, then the fan should be turned on like that the program has been flashed in the processor so if temperature is high then the fan will be turned on and the damage will be avoided.

IV.CONCLUSION

If RTOS based online condition monitoring gets implemented all the electrical equipment will get monitored continuously.

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So before fault occurrence chance of fault has been detected. Due to this entire kit damage has been reduced considerably. The diagnosis process carried out after online monitoring. If fault detected that has been recovered by the recovery unit. And this recovery unit acts as an interface between ARM7 and the electrical equipment which we are going to connect. Advantages of this RTOS based online condition monitoring are it reduce machine component damage, avoids system abrupt shutdown, support effective resource management, advantage in the production, cost effective.

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