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Predictive Maintenance For Hydraulic System

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ABSTRACT—Production losses in the industry are a serious issue which must be reduced to a minimum level. The continuous working of production lines, sometimes, is hindered due to several factors. All productions lines consist of moving parts and hence the wear and tear of parts is inevitable in any industry. While there is no scope of eliminating the mechanical parts, we certainly can monitor the status of these parts and take the necessary action from time to time. This step ensures that the loss is minimized since it introduces a window to take the required action without any long term hindrance. There is not a fixed method to implement the monitoring of parts (for ex. valves, sensors etc.), the user is free to choose a suitable method for carrying out the monitoring. One such method is predictive maintenance: it is the maintenance of plant equipment by using various algorithms and analysis technique. It is essentially the alert maintenance system. The system consist of microcontroller [11] model will help to determine the most probable time of machine or system equipment failure. The algorithm will analyze the data and take the assigned action which could be just alert or shutting system down to avoid risk equipment of damage to other equipment of plant. The data abstraction and data recording is the first and important step of the whole system. Second is the analysis based on the data given and third step will be the action according to the input data. The process will be repeated after a fixed interval of time to get more precise result for the plant.

Keywords—monitering, analysis, microcontroller, algorithm, data abstraction

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I. INTRODUCTION

Most of the present systems shutdown immediately when a system failure occurs, this leads to some serious drawbacks in the flexibility of the system which mainly includes: High maintenance costs, Limited equipment life, Increased downtime and deteriorating production quality. Thus, there is a need of having a predictive maintenance technique inbuilt in a system which helps overcome these downsides.A study was made by M. S. Lande, P. M. Sirsat and R. S. Tupkar [2] to familiarize maintenance personnel with the basic information necessary for servicing and repairing of DT40 CNC Milling Machine. Also Jeffrey K Jone & James White discussed about predictive maintenance method and apparatus for use with heating ventilation, air-conditioning and/or refrigeration (HVACR) system [3].The program developed by Jeffry Jone uses the data entered by maintenance officer and gives the prediction about any failure of the system using graphs, tables and prediction commentary. Hong Bae Jun & Dimitris Kritsis introduced the research issues on closed-loop product lifecycle management (PLM) [4]. The main objective of the research was to provide right information in the right context at the right time to the consumer of the product. During this research several problems were explored and requirements for resolving them were addressed. Hence, the main aim of predictive maintenance is to predict when equipment failure might occur. Anticipation of future failure allows maintenance to be planned before the failure occurs. Many studies and researches based on predictive maintenance system were published and were useful during project completion.

This paper is categorized as follows. The working and construction of theidea is introduced in Section II. The illustration of a model based on the idea is described in Section III. Section IV highlights the future work followed by concluding remarks in Section V.

II. CONSTRUCTION AND WORKING

Hydraulic systems are widely used in industries for different applications. One such application is the power pack machine [16]. It has an oil tank and cylinders. Thus the process parameters in this case are pressure and temperature and level of oil in the tank. Any system in the world has its life. After a certain time period, the machine parts start to degrade and hence errors occur. Now, these minor errors after a point result into machine failure. Thus Predictive Maintenance can prevent this machine failure. This is done by measuring various parameters in real time, analyzing them and accordingly performing the required set of actions. The sensors used to capture data will be placed at different points.

The temperature sensor will be used to monitor temperature of oil. The initial temperature of oil will be sensed and stored. Similarly as the system starts its operation the data will be stored. Now a certain value of temperature of oil is given as a set point i.e. oil temperature must not exceed this value and if it exceeds this condition it will be sensed by the sensor and since limit has been crossed a counter will be generated which will be incremented every time temperature increases above that value. This will be the alert condition. Along with this there is a temperature limit which if exceeded for a larger number of time signifies that something is wrong in the system and especially around oil tank because the parameter is temperature. So based on the number of times there is a situation where temperature is exceeded there will be prediction done that the parts must be kept available for replacement. Due to this there will no sudden failure as the system will predict the failure before it occurs. Similarly, level sensor will monitor the level of oil in the tank. And pressure sensors will monitor the pressure at different points. The real time data from all sensors will be stored in MS-EXCEL. For the interfacing of microcontroller and excel we have used a software named as Parallax. The sensors will be connected to microcontroller. Microcontroller used for this purpose is BLAU. Coding for this microcontroller is done in Arduino-IDE. Using various interfacing instructions microcontroller exports data into Excel. Continuous real time data can be viewed in Excel spreadsheet. Further, the conclusion i.e. messages or actions to be taken will be indicated on a HMI display. The HMI used is Nextion HMI and the software used for the interfacing purpose is Nextion Editor. Thus the predicted messages along with count and the current value of that particular message will be displayed on the HMI [15].

Fig 1. Oil Tank of the power pack unit

III. ILLUSTRATION

In this project we have used various sensors which are mainly used for measuring the common variables such as pressure, temperature, level etc. In this system we have used BLAU microcontroller, Ardiuno and Nextion HMI screen. Blau microcontroller is a controller which takes the input from the sensors and performs the algorithm and produces the output which will be displayed on HMI screen. To store the previous data and to observe the trend we have used parallax software which is used for the interfacing of ardiuno and excel. The nextion HMI is used to display the current reading as well as the trend of the values in the form of graph. The temperature sensor used in our project is RTD PT100 and this temperature sensor is used to measure the temperature of the oil inside the oil tank. Level sensor is used for measuring the level of the oil inside the oil tank so that in case any leakages are there in system then they can be identified and immediate action can be taken. Pressure transmitter used works on 24 VDC supply and gives the output as 4-20mA. This pressure transmitter can be used for measuring pressure up to 400bar. Using the data given by this sensors we are going to perform predictive algorithm which is going to compare the current value of the variable with the previous value and test if the value is between the appropriate range or not . If the count value goes beyond acceptable value the algorithm is going to display the alert message and the required actions or instructions to be performed to reduce the risk and avoid any dangerous situation. Hence using this predictive maintenance system the risk can be reduced and damages can be avoided there by increasing the productions and efficiency of the production system in industry.

Fig 2. HMI display along with messages

Future Work

Future work will include interfacing the system with GSM so that the maintenance officer will get the prediction messages directly irrespective of the time and place where he is. Also currently we are using two microcontrollers for the storage and prediction part respectively. So, our further focus will be to integrate it on one board.

IV. CONCLUSION

Most of the present systems, shutdown immediately whenever a system failure occurs, it increases downtime as well as results in production

loss. This leads to some serious drawbacks in the flexibility of the system.The main objective of predictive maintenance is to predict when equipment failure might occur, monitoring for future failure allows maintenance to be planned before the failure occurs.Thus, it will be an important step towards the industrial point of view

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