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CONDITION MONITORING AND PREVENTIVE MAINTENANCE IN DIGITAL CHECKLIST FOR MACHINERY USING ANIMATION

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Abstract

The performance of the machinery in industries can be maintained by following a certain procedure to lead the machine in its routine work. This can be achieved by the condition monitoring and preventive maintenance techniques, which prevents the machine from unexpected failure. Checklists support the machinery to perform all the sequence of operations in a certain procedure that has to be done repeatedly. In this paper, the condition monitoring and preventive maintenance are applied for the machinery with digital checklist process using animation. By using digital checklist, it confirms its machinery and its parts are in intact and improves the performance of the machines on daily or shift wise basis. Using digital checklist, the condition monitoring and preventive maintenance of the machine are monitored continuously, which prevents the machine from failure and also helps the user to perform the operation of the machine in an easier way. It is proved experimentally that the machine is monitored and prevented effectively.

Keywords: condition monitoring, preventive maintenance, checklist, animation.

1. INTRODUCTION

Industries are gradually depending on the performance of theirmachineryto be digitized to remain in the competitive world. The digital machinery helps them to provide accurate and timely maintenance of the machinery and to attain the organizational benefits. Condition Monitoring (CM) in machinery has gained thrust for the past few years, it has become a necessary component for the recent industrial areas to achieve high reliability, and the work is scheduled for the machinery to increase the maintenance. Condition monitoring is a process of continuously inspecting and monitoring the performance of the machine, to reduce the downtime and to maintain the quality of the machine. It also provides earlier failure detection of the machinery before a deterioration or the breakdown occurs. It also reduces the life cycle cost, provides the worker safety, machinery safety, and retains the quality of the product. The effectiveness and the maintenance of the system are improved. It provides enhanced way to make the decision for operation of the machine, maintenance staff and the management.

Condition monitoring follows the parts of the machine that has to be controlled in processing. It performs a major role in the maintenance, operation of the machines and supports the management for making decision effectively. The main objective is to

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resolve the precise moment in which maintenance has to be done for the machinery and to identify the more suitable action [13] that has to be performed.

Preventive Maintenance (PM) is the standard and repeated maintenance of the parts of machinery to maintain them in execution, to avoid from unexpected downtime and failure. The machinery is maintained worthy, by planning and scheduling the job perfectly prior to the trouble occurs. Nowadays, most of the industries apply preventive maintenance software to arrange the repeated maintenance tasks of the machinery. The digital checklist guides the type of inspection, maintenance that is needed for the system. It also improves the reliability and the life of the machinery.

Digital checklist for machinery supports the industry in an organized way to help the user to perform the steps easily without skipping any steps in the system. Checklists play a major role in digital automation techniques. In [1], the author reveals that the projects with checklists used for estimating, have shown precise estimates when compared to the projects without checklists. Checklists improve the consistency, the precision and the estimates of the process. It also increases the assurance in the estimation of the machine and the delivery of the product.

This paper illustrates that, the condition monitoring and preventive maintenance of the machinery is done using digital checklist process with animated effects. The process minimizes the manual work and the performance of the machinery can be maintained. The checklist for the vacuum lifter [5] maintenance is performed to operate the machine reliably. The animated effects of the proposed method support the user to handle the machine effectively without failures.

The proposed method is implemented to increase the performance of the machinery by applying the Condition Monitoring and Preventive Maintenance technique with the digital checklist automation process using animation to improve the user job.

The paper is organized as follows. In section 2 discusses the works related to this paper. Section 3 explains the proposed method and its implementation. Section 4 gives the conclusion and the future work of the proposed method.

2. RELATED WORKS

Condition Monitoring in general, suggest a set of maintenance that are necessary for the machinery in the occurrence of failure or fault of the machine, named as condition-based maintenance [16]. It is examined as a method of preventive maintenance, and supports in developing maintenance scheduling effectively. If the preventive maintenance tasks and plans are provided effectively, then the inspection of the machine is also improved [10]. The paper [11] explains in detail on PM planning, and gives the suggestion for the applications in real industries. After recognizing the need of

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prevent failure for the machines, Preventive maintenance came into existence in the year of 1950's. The essential attitude of a PM system involves the prespecified maintenance tasks, which is based on the function of the machine and the lifetime of the component. Consequently, the tasks can be made to alter the components of the machine prior to the failure occurs.

Continuous monitoring of the system is a most protected part for earlier detection of the failure of the machinery, it also reduces the system downtime and save money [4]. Condition monitoring is a maintenance technique that monitors the condition of a machine or the structure of the machine and reports when maintenance has to be done for protecting the machinery from failure. Preventive maintenance is done in spite of the machine's status and is based on when the machine has to recover before failure occurs. The paper [9] mentions a method that supports the scheduling of preventive maintenance that is integrated in a computerized maintenance management of the machinery. The managerial view schedules in planning and deciding the proper feasible solutions [12] before performing the PM, hence forth to achieve the goals. The suitable planning of the execution of PM actions makes the system efficient and effective.

The use of conditional monitoring makes the maintenance to be scheduled perfectly and other actions to be done correctly, which supports to prevent failure and avoid its consequences [13]. Condition monitoring tool is assessed in grinding machines for experimentation [14]. The real time CNC machines are monitored with conditional technique at various places [6]. In [15], the condition-based monitoring is explained with the theoretical and practical growth of the machinery and its developments are discussed.

Checklists supports in machinery and gives a massive performance to provide safety and accuracy that are necessary needs and also reduces human errors [2]. A software cost management process and a preface customized checklist is proposed by Jorgensen [7]. The checklists are improved by splitting the complex tasks into smaller tasks and by removing the unneeded tasks for long period of time [3]. Improvement of the checklist estimation is discussed in [8].

3. PROPOSED METHODOLOGY

The proposed method is applied with Condition Monitoring and Preventive Maintenance techniques in digital checklist automation for machinery with animation effects. This method supports the users to handle the machine in a user friendly way, reduces and makes the work easier for the user. The animation effects help the user to locate the machinery parts easily and effectively. The monitoring of the machine and preventing from failure are followed continuously to protect the machinery.

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3.1 IMPLEMENTATION

The proposed method was implemented using React as Front End and MySQL as Back End in NodeJS Environment.

In this method, the process of Preventive Maintenance using closely looped animated application is followed which clearly shows, what has to be looked for and corrected before a shift starts for every machine and for all users using the machine. During the same process, the condition of the machine (Condition Monitoring) is being tracked with various inputs about the machine from users while using the machine shift wise.

A user on the shift starts the application automatically, prompts for the machine current status with animated graphics, what is to be checked for and the same is specified in graphical form with the location of the machine.

Fig. 3.1 indicates the automated maintenance for various machines. The User / Maintenance Department / Management decides on predefined checklist of every machine, what parts has to be checked for each shift. By this process the management confirms or gets assurance about the machines performance, user safety. The Condition Monitoring and Preventive Maintenance of the machine are in intact with the maintenance department.

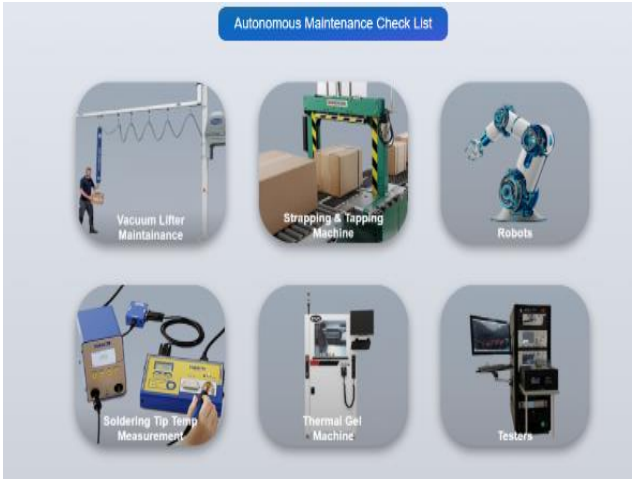

Fig. 3.1: Automated Maintenance

The Condition Monitoring and Preventive Maintenance techniques are applied to improve the working of the equipment. The Lifting handle and pad Cleaning Checklist shown in Fig. 3.2 is to check for dirt. It is seen through eyes and cleaned. If Preventive Maintenance have issues then it will be reflected to escalated technicians, supervisors and department heads.

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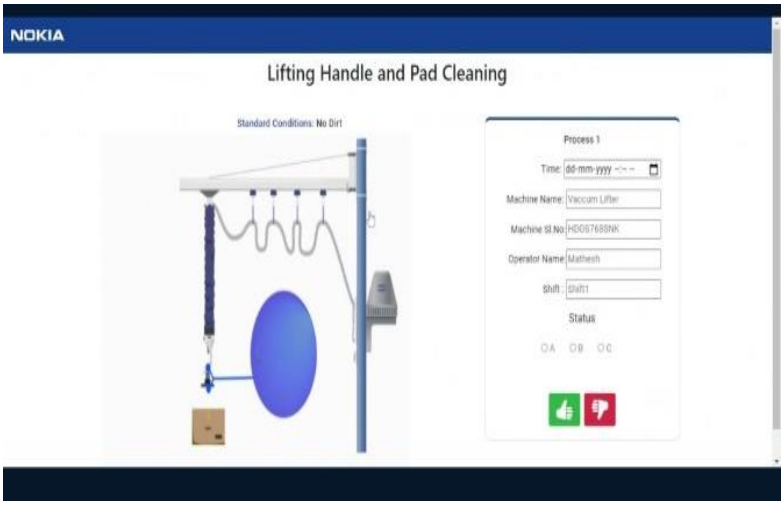

Fig. 3.2: Lifting Handle and Pad Cleaning

In Fig. 3.3 Check for Vacuum Hose, the Part is zoomed out in the application and it shows how the part should be. Check if the vacuum hose is connected properly. It is checked through eyes and ears, for checking any leakage exists in the hose. If the Vacuum Hose is in intact without any damage than the user just clicks ‘OK’ Button (Green Thumbs up Button). If it is not ok, any damage is noted the user clicks ‘Not OK’ Button (Red Thumbs down Button). By this way, the machines Maintenance issues is recorded shift wise. Similarly, the same method is used to evaluate the machines condition and the application escalates the ‘Not OK’ records to the Maintenance Team and to the Top Management.

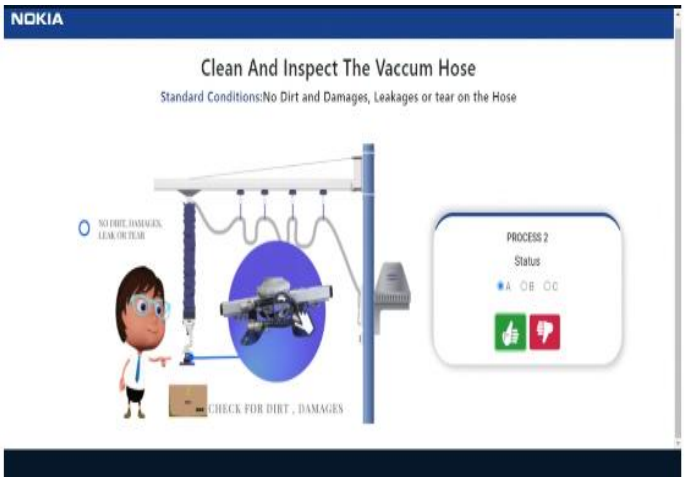

Fig. 3.3: Clean and Inspect Vacuum Hose

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The Vacuum pressure gaugeshown in Fig. 3.3is tocheck the vacuum pressure gauge of the machine.

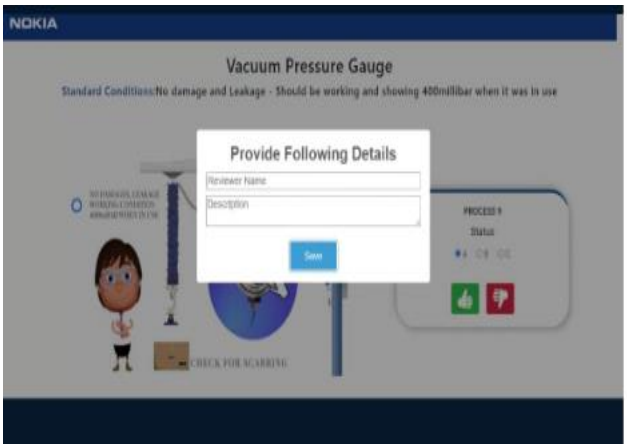

Fig. 3.4 Vacuum Pressure Gauge

Fig. 3.5 shows the checklist of soldering tool tip temperature and soldering cartridge type. Here the user has to check the soldering temperature for which the temperature with +10 or -10 degrees is allowed for the performance of the machine.

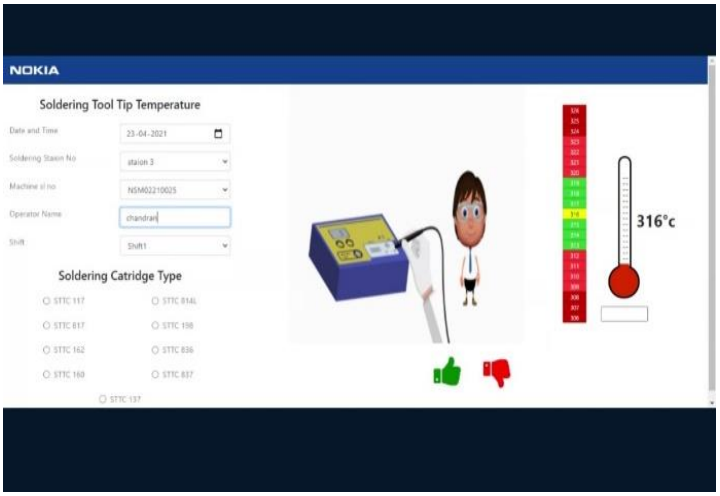

Fig. 3.5: Soldering Tool Tip Temperature and Soldering Cartridge Type Process

Fig. 3.6 shows a Green Mark is enabled on each checklist option while the checklists are successfully completed. If the particular user does not undergo the checklist, will be intimated to the user and it has to be performed immediately by the user, and then the maintenance department will recover it.

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Fig. 3.6: Mark on Successful Checklist

Fig. 3.7 shows the maintenance of the vacuum lifter database.

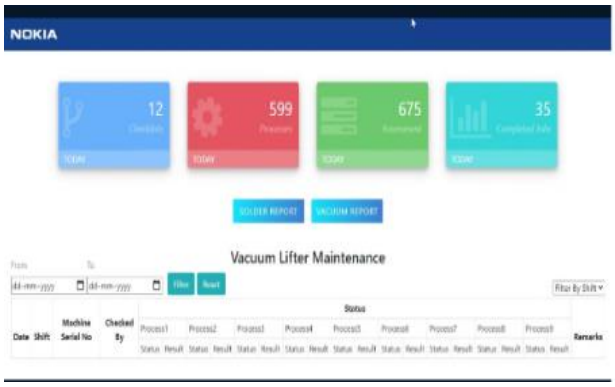

Fig. 3.7: Vacuum Lifter Maintenance Database

Fig. 3.8 specifies the final test OTA AM checkpoints for entire cleaning process.

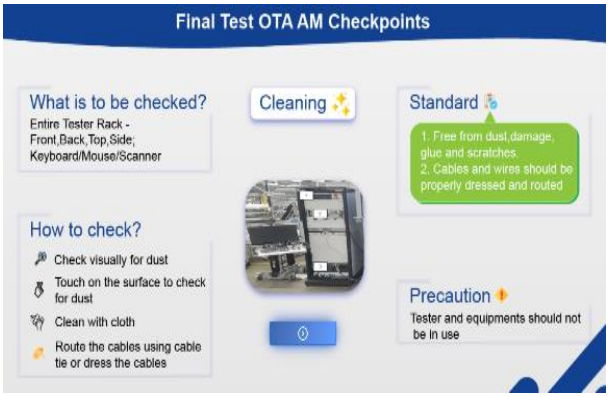

Fig. 3.8: Final Test OTA AM Checkpoints for Entire Cleaning Process

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Fig. 3.9 specifies the final test OTA AM checkpoints for entire inspection process.

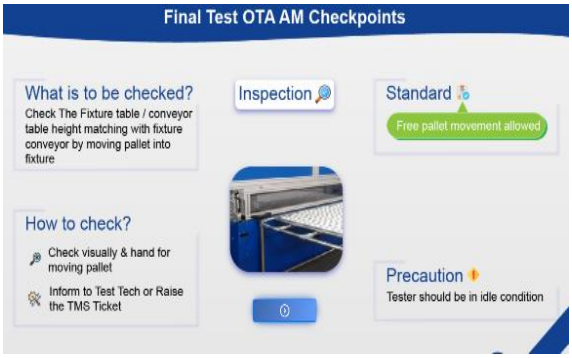

Fig. 3.9: Final Test OTA AM Checkpoints for Entire Inspection Process

This method monitors the machine continuously and prevents the machine from failure with the digital checklist automation process using animation. The user identifies the problems in the machine easily and it is being rectified immediately. The implementation of the method, makes the work easier for the users, and it can be followed by the maintenance department and the management.

4. CONCLUSIONS AND FUTURE WORK

In this method the condition monitoring and preventive maintenance techniques supports the machinery to perform its task in best way with the digital checklist automation process using animation method. The digital checklist confirms its machinery and its parts are in intact and by this, the performance of the machines on daily or shift wise is improved. This method reduces the downtime and maintains the quality of the machine and its performance. It also helps the user to perform the operation of the machine in an easier way. The automation is done for various machines. This method increases the performance and the efficiency of the machinery effectively.

Automation is an inevitable trend in digital workstation software application. In future work, the automation shall be implemented using AI, cloud computing and robotics. To achieve higher efficiency, Robotic Process Automation (RPA) technique will be applied to perform the redundant and repeated task that suits the machines instead of human labor.

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