Smart maintenance of continuous duty cycle motors

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Abstract. Maintenance is a considerable part in the efficient working of the continuous duty cycle motor, especially in the motors used in day-to-day usage. It is practically impossible to do routine manual checkups to ensure the motor is safe and working conditions. The only relevant solution is to automate the routine checkups of the motor. This work's primary objective is to develop an automated solution to the task of regular maintenance of the continuous duty motor. Here a wireless module using Arduino is integrated with the motor to wirelessly oil the motor. The proposed system can be used for regular oiling and machine maintenance without having the hassle of going to the site. Using this machine, the employee can check the working condition of the machine and turn ON and OFF the oiling system for the required duration. The proposed system prototype working has been tested and verified.

1. Introduction
In this modern world, the applications of motors are limitless, and a wide range of machines are used daily. The continuous duty cycle motors are integrated for the working process, as the chief component for various applications. The different uses of the motor are in lifts, escalators, paper mills, conveyor belts, electric point machines, Industrial motors, electric vehicles and many more. As the use of motors are limitless but when it comes to maintenance of these motors the solutions is only manual maintenance. For bigger machines, the cost of the motors for replacements is relatively high if they are not maintained properly at the regular intervals. There are a lot of problems that can occur due to nonregularity of maintenance and there are many aspects to look into for the regular maintenance of the motors such as checking the input supply to the motor, checking the wiring of motors, regular oiling of the motors, winding failures/faults and many other electrical and mechanical faults [1]. Various automation systems are discussed in the literatures which are used for home automation system [2-10].

A house hold power rate consumption monitoring system was built in real-time by the authors in [2]. It provided customers with visual details using human-machine interface. The authors in [5] developed a server independent internet-of-things based control of human desired home appliances. Using Arduino-conveyor system, automatic water filling machine is proposed in [8]. The authors in [11] developed a security system along with smart home automation. In this paper, one of the faults and the ways to rectify is discussed in detail. The automation to rectify fault is also discussed. The fault discussed in this paper is the need for oiling of the motors and the way to automate the task for regular maintenance. This paper shows how an Arduino can be programmed to turn ON and OFF a pump with which oil can be inserted and stopped from flowing into the motor oiling hole. A SMS based automation is done, so it can be used with any phone on the registered mobile number [11].
2. Background and literature
The oiling of the motor plays a vital role in extending the lifetime and the working process of the motor. Routine checkups and routine oil cleanups need to be done to ensure efficient working. If the amount of oil present is insufficient a lot of damage can occur to the motor which can lead to failure in operation. Some of the causes of insufficient lubrication maybe:

- Oil levels being too low.
- Wrong types of oil being used (only oils permitted by the manufacturer maybe used).
- Oil may become contaminated due to asbestos and dirt particles.
- Oil filters need to be maintained properly and checked from time to time.
- Carbon or dirt build ups in the inlet pipe leading to insufficient oiling.
- Oil feeds pumps maybe bent or twisted.

Oiling being one of the faults of the electric motor there are several other faults which when not addressed properly can affect the working condition and the life cycle of the motor. Some of which are:

- Low insulation resistance: This happens overtime when the motor does not go through the regular maintenance as the motor keeps running its insulation resistance starts to deteriorate which leads to short circuits and leakages which can cause the motor to malfunction and eventually fail. It usually happens due to corrosion, physical damages and can be avoided by doing regular maintenance and checkups.
- Overheating and Over-current: As the name states over-current occurs due to over voltage and current above the motors rated value which lead to overheating of the motor which can reduce the lifespan of the motor and damage the components inside. Overheating can also occur due to harmonics in the current.
- Vibration in Electric motors: Vibration faults in electric motors are caused mainly due to loose bearings, corrosion and other physical damages if not maintained properly can reduce efficiency or even cause motor to malfunction. This can be avoided with proper maintenance.
- Faults due to dirt and liquids: Dirt inside the motor can cause resistance to the rotation of the motor and liquids can cause damages such as corrosion or damage the power circuits in the motor. These can be avoided by proper cleanup and maintenance of the motors.

3. Working of proposed system
Depending on the type of motor used the usage of the oil machine may differ and can be modified by using the code or physical modifications to the pipe structure for the oil inlet valve. In this work, very basic and simple codes to automate the oil pump to start, when it is required. And when it is required the stop function has to be enabled. It can also check the working condition of the pump if necessary.

Figure 1 shows the flowchart which describes the working of the oiling machine. After the circuit is in ON condition it can be ready to turn ON the motor. When a SMS with the acknowledgment words programmed according to the user is sent to the Arduino it turns ON the pump and gives a reply saying it has successfully turned ON the pump and oiling is taking place. After the required time, the user can then turn OFF the pump by sending the SMS programmed by the user to turn it OFF and it sends an acknowledgement saying the motor has turned OFF. The oiling system can also be checked for working condition by sending a test SMS and if it replies the system is working fine it is or else it has to be checked manually for working. The system can be further improved by automating the oiling schedule for easier maintenance by modifying the code used.
4. Wiring and design of circuit

The wiring of the circuit is relatively simple. The main components to be wired being the Arduino UNO, the GSM module and the oil pump. Figure 2 shows the circuit diagram of wiring of the circuit.

The steps followed to implement an automated wireless oiling machine for motor is given below:

- A transformer is used to step down the 230VAC to 12VAC as required by the circuit and bridge rectifier converts AC into DC current which further passes through an electrolytic capacitor to smoothen the power supply as required by the circuit.
- A 12V voltage regulator powers up the GSM modem, Arduino and relay. The GSM modem is connected to Arduino at the required pins no.0 and pins no.1, which are RX and TX respectively.
- The RX and TX of GSM and Arduino are connected and the TX and RX of GSM and Arduino are connected respectively.
- GSM and Arduino are grounded.
- The relay is driven by the Transistor and the diode prevents voltage spikes from switching relay ON and OFF.
- The led shows if the relay is in ON or OFF condition and is illustrated shown in figure 3 and figure 4 respectively.
- A SIM card with data plan should be inserted into the GSM module.

**Figure 2.** Wiring circuit of automated oiling machine

**Figure 3.** Circuit of automated oiling machine with ‘OFF’ condition
5. Conclusion
A remotely controlled oiling machine for continuous duty cycle motors is implemented in hardware using ATmega328 microcontroller on Arduino Uno. The system can be used for regular oiling and maintenance of machine without having the hassle of going to the site. Using the proposed machine, the employee can check the working condition of machine and turn ON and OFF the oiling system for the required duration. The proposed system prototype working has been tested and verified. Even more modifications can be made so that scheduled oiling can take place.

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