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Literature Review on Gear Deburring System

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Abstract - *The present paper gives an overview regarding the gear deburring system. The objective of this paper is to deliver a predispose about an automated & system integrated machine named as r Gear Deburring System' with the help of the data obtained by thorough research and development techniques. The subsequent machine contributes to the precise delivery of sophisticated deburring operation performed on a part named 'Gear', which is primarily used in power transmission.*

Key Words: *Spur gear,helicalgear, gear design, contact, burr removing, etc.*

1. INTRODUCTION

A gear is one of the most common mechanisms that transfer power from one machine to the other. In most of the automobile industries, the spur gear is mainly used to support and carry the power and transmit. The gear mounted on the driver shaft is called driver gear and another gear mounted on the driven shaft is called driven shaft. Maintaining the quality of the thread is basically of paramount importance and it can be done so by the versatile spur gear, which performs consistently well – both in conventional and compact systems. From the design viewpoint, fatigue strength and wear are the most important criteria because each gear tooth may experience billions of load cycles.

Automation of the finishing process would prove to be very beneficial. Presently manual finishing accounts for 12% of the total labor cost and approximately 10% - 30% of the manufactured parts need rework after the manual finishing process. By automating the finishing and deburring process, tolerances could be held to less than 0.07 mm (0.003 in), the finishing costs could be reduced as much as 50%, and the rework rates could be nearly eliminated.

Traditionally, robotic automation has been accomplished through the use of computerized programming method. This method of programming is only acceptable for simple paths and large parts runs. When parts become complex or when only small numbers are produced, this method becomes impractical. Any random programming software is tedious, time consuming and prone to inaccuracies. For complex geometries, such as arcs and splines, hundreds of points need to be taught along the surface for a robot to perform the trajectory accurately. Therefore, usable autonomous finishing system must have the capability to use CAD models to quickly and accurately generate the necessary finishing trajectories based on the knowledge.

2. Purpose

Gearing is one of the most critical components in mechanical power transmission systems. The transfer of power between gears takes place at the contact between the mating teeth. During operation, meshed gears‟ teeth flanks are submitted to high contact pressures and due to the repeated stresses, damage on the teeth flanks, in addition to tooth breakage at the root of the tooth are one of the most frequent causes of gear failure. This happens because of poor finishing and deburring process. The purpose of this paper is to eliminate those problems.

3. Spur Gear Nomenclature

Pitch surface: The surface of the imaginary rolling cylinder that replaces the toothed gear. Pitch circle: A normal section of the pitch surface.

Addendum circle: A circle bounding the ends of the teeth, in a normal section of the gear. Dedendum circle or Root circle: The circle bounding the spaces between the teeth, in a normal section of the gear.

Addendum: The radial distance between the pitch circle and the addendum circle. Dedendum: The radial distance between the pitch circle and the root circle.

Clearance: The difference between the Dedendum of one gear and the Addendum of the mating gear.

Face of a tooth: That part of the tooth surface lying outside the pitch surface. Flank of a tooth: The part of the tooth surface lying inside the pitch surface. Top land: The top surface of a gear tooth.

Bottom land: The bottom surface of the tooth space.

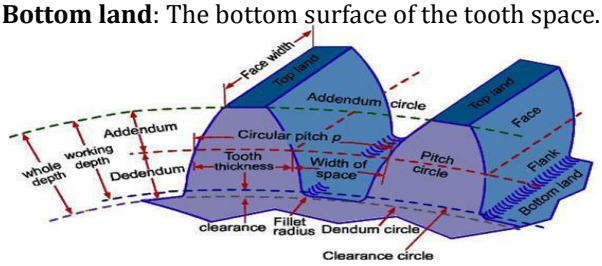

Fig 1 Involute Spur gear

4. RESEARCH WORK OF DIFFERENT LITERATURES

Jonny Harianto et al [1] 2007 has derived that this paper presents a method for evaluating the effect of

microgeometric or microtopographic variation on various gear performance parameters, i.e., noise excitations, gear contact and root stresses, film thickness and surface temperature under loaded conditions. Micro geometries that are considered are profile crown, profile slope, lead crown, lead slope and bias modifications variations. Various combinations of these micro geometries are considered in analytical simulations in which respective gear design metrics are evaluated based on the calculated load distributions. This paper will provide a walk-through analysis for a helical gear design in order to describe the procedure.

Perfect involute profiles of both spur and helical gears only exhibit conjugate motion at no load conditions. Once load is applied to a gear pair, deflections occur and the motion transfer is no longer conjugate. In order to get the motion back to some semblance of conjugacy, the tooth profile is modified, usually by the removal of material from portions of the tooth surface. Profile modifications in the form of tip or root relief compensate for tooth bending deflections, and lead modifications in the form of either lead crown or end relief compensate for manufactured lead errors, shaft misalignments and shaft deflections.

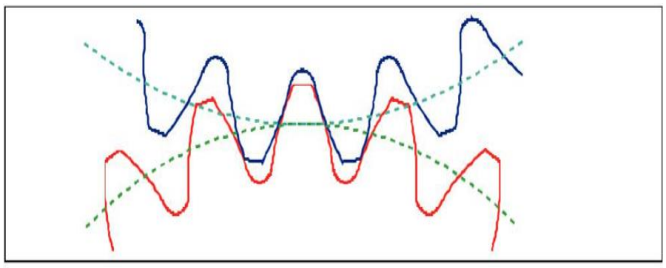

Fig.2 Schematic of Gear in Mesh

This paper has presented an interactive, graphical procedure for determining gear tooth topography designs that minimize the noise and stresses of gears. The method is also a valuable educational tool for understanding the effects of numerous topographical changes of the tooth surface on gear performance.

B.Venkatesh et al [2] 2010 has mentioned that the Marine engines are among heavy-duty machineries, which need to be taken care of in the best way during prototype development stages. These engines are operated at very high speeds which induce large stresses and deflections in the gears as well as in other rotating components. For the safe functioning of the engine, these stresses and deflections have to be minimized. In this work, structural analysis on a high speed helical gear used in marine engines, have been carried out. The dimensions of the model have been arrived at by theoretical methods. The stresses generated and the deflections of the tooth have been analyzed for different materials. Basically the project involves the design, modelling and manufacturing of helical gears in marine applications. It is proposed to focus on reduction of weight and producing high accuracy gears. From the results, it is observed that the bending and compressive stresses of aluminum alloy (ceramics) are less than that of the other material like steel. Aluminum alloy reduces the weight up to 55-67% compares to the other materials.Aluminum is having unique property (i.e. corrosive resistance), good surface finishing, hence it permits excellent silent operation.Weight reduction is a very important criterion, in order to minimize the UN balanced forces setup in the marine gear system, there by improves the system performance.Hence aluminum alloy is best suited for marine gear in the high-speed applications.The designed gear set have been manufactured using gear hobbing technique and finished by gear shaving operation and tested for the strength of the gear teeth.

V.Rajaprabhakaran et al [3] 2010 has concluded that the Gears are commonly used for transmitting power. They develop high stress concentration at the root and the point of contact. The repeated stressing on the fillets causes the fatigue failure of gear tooth. The main objective of this study is to add different shaped holes to reduce stress concentration. A finite element model of Spur gear with a segment of three teeth is considered for analysis and stress concentration reducing holes of various sizes are introduced on gear teeth at various locations. Analysis revealed that aero-fin shaped hole introduced along the stress flow direction yielded better results. The surface failures occurring mainly due to contact fatigue are pitting and scoring. It is a phenomenon in which small particles are removed from the surface of the tooth due to the high contact stresses that are present between mating teeth. Pitting is actually the fatigue failure of the tooth surface. Hardness is the primary property of the gear tooth that provides resistance to pitting. In other words, pitting is a surface fatigue failure due to many repetitions of high contact stress, which occurs on gear tooth surfaces when a pair of teeth is transmitting power. Gear teeth failure due to contact. Fatigue is a common phenomenon observed. Even a slight reduction in the stress at root results in great increase in the fatigue life of a gear. For many years, gear design has been improved by using improved material, hardening surfaces with heat treatment and carburization, and shot peening to improve surface finish etc.

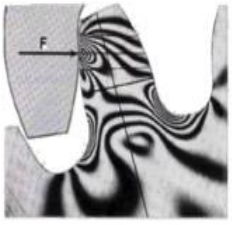

Fig. 3 Spur tooth stress analysis

Spur gears are the most common type of gears. They are used to transmit rotary motion between parallel shafts i.e., they are usually cylindrical in shape, and the teeth are

straight and parallel to the axis of rotation. Sometimes many spur gears are used at once to create very large gear reductions. Spur gears are used in many devices but not in cars as they produce large noises. The main aim of the above study is to relieve stress from the maximum value to as minimum as possible. So the highest point of contact of teeth is selected as pressure application point which causes highest stress. Stress relieving feature having a shape of aero-fin is used in the path of stress flow which helped to regulate stress flow by redistributing the lines of force. This also yielded better results when compared to elliptical and circular holes. In this study, the best result is obtained by introducing aero-fin hole at (38.7653, 65.4083, 0) and having scaling factor of 0.6. The result displayed a stress reduction by 50.23% and displacement reduction by 45.34%.

Kyle Stoker et al [4] 2010 has mentioned that the current practice of gear design is based on the Lewis bending and Hertzian contact models. The former provides the maximum stress on the gear base, while the latter calculates the contact pressure at the contact point between the gear and pinion. Both calculations are obtained at the reference configuration with ideal conditions; i.e., no tolerances and clearances.
The first purpose of this paper is to compare these two analytical models with the numerical results, in particular, using finite element analysis. It turns out that the estimations from the two analytical equations are closely matched with those of the numerical analysis. The numerical analysis also yields the variation of contact pressures and bending stresses according to the change in the relative position between gear and pinion. It has been shown that both the maximum bending stress and contact pressure occur at non-reference configurations, which should be considered in the calculation of a safety factor. In reality, the pinion-gear assembly is under the tolerance of each part and clearance between the parts. The second purpose of this report is to estimate the effect of these uncertain parameters on the maximum bending stress and contact pressure. For the case of the selected gear-pinion assembly, it turns out that due to a 0.57% increase of clearance, the maximum bending stress is increased by 4.4%. Due to a 0.57% increase of clearance, the maximum contact pressure is increased by 17.9%.
A method to properly develop the gear and pinion geometries has been developed parametrically in ANSYS. With the help of this program, the implementation of many different geometrical configurations can easily be obtained. The finite element method is a good means to solve this problem for a spur gear model.

Dr.R.J.Patil et al [5] 2014 has derived that Previously for gear tooth chamfering machines were used and that machines are manually operated. To atomized this manually operated machines we can used the hydraulic mechanism or pneumatic mechanism to apply force on the top side of the gear plate i.e. vertically downward force to clamp gear plate fixed where amount of applied force must be greater than the amount of cutting force. If this applied is less than cutting force then the gear plate will not have a steady state. Here application of hydraulic mechanism is suited as compare to pneumatic mechanism considering cost, heat transfer capacity and leakage problem.
Initially the gear tooth chamfering was manually, we modified the entire operation in to automatic process by developing hydraulically operated automated gear tooth chamfering system. We can reduce machining time around 40 to 50% by adding this new hydraulic mechanism in the existing system of tooth chamfering machine and provide some sort of relief to the workers. It will also reduce human requirement for the chamfering of the gear tooth.
Sachianand Vishwakarma et al [6] 2014 has mentioned that The objective of this paper is to deliver a predispose about an automated & system integrated machine named as 'Cot Chamfering Machine' with the help of the data obtained by thorough research and development techniques. The subsequent machine contributes to the precise delivery of sophisticated chamfering operation performed on a part named 'Rubber Cot', which is primarily used in textile industries. This prescriptive paper offers genuine concepts & overview of the research and development done on the respective machine along with the basic introduction about the same. The machine has the huge scope for development as it is being an automated & system integrated machine and the same has been portrayed in the paper.

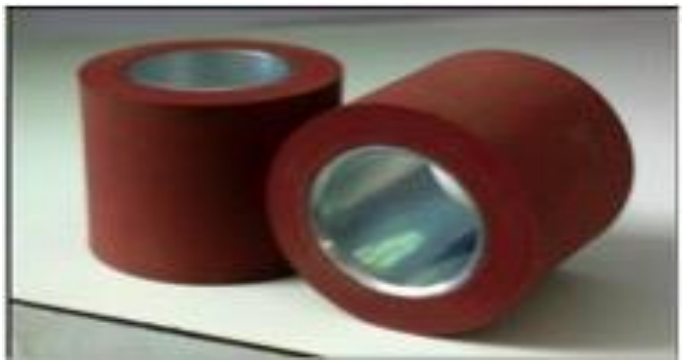

Fig.4 Rubber cots with and without deburring

From all the research, development and their implementation, it can be concluded that the precise and simultaneous chamfering operation on the rubber cot is achieved successfully by the automated & system integrated machine. The variations in the size of the rubber cot can easily be compensated but the key feature of such automated machine is that, the variations in the chamfer are also compensated without any hassle. The rubber cots, being disposable products, they are used in very high quantity throughout all the various textile industries. Hence, there is rapidly growing market for this

machine in near future. This unique machine can also be used along with bowl feeder & conveyor assembly to achieve complete automatic loading of jobs in the cot guiding chute and hence, the objective of this project is thus fulfilled.

K.Rahul Kanna et al [7] 2015 has derived that the Runout is a characteristic of gear quality that results in an effective centre distance variation. In other words, the amount a gear or wheel moves in and out away from its true centre as it is rotated. Runout causes backlash in gears, accumulated pitch variation and noise during the transmission of gears in motion. The goal of our project is to reduce the runout in the speed gears of the input and output shafts. The solution is achieved by analysing the machining line of the gears and the problems are narrowed down by using of the tools of quality. The problems faced are resolved with the implement of new solutions.The budding face width of the basic wear part called flange is increased to have a higher stability which reduces the vibration. A collet is introduced in the main bunk to have a firm grip for the work piece. The implementation of these solutions results in the reduced runout in gears which enables the quality of the gears to reach closer to the specification.
A gear is a rotating machine part having cut teeth, which mesh with another toothed part to transmit torque, in most cases with teeth on the one gear being of identical shape, and often also with that shape on the other gear. Geared devices can change the speed, torque, and direction of a power source.
Helical or "dry fixed" gears offer a refinement over spur gears. The leading edges of the teeth are not parallel to the axis of rotation, but are set at an angle. Since the gear is curved, this angling causes the tooth shape to be a segment of a helix.The hand of helix is designated as either left or right.Most of the transmission gears are helical gears since higher strength compared with a spur gear, more effective in reducing noise and vibration when compared with a spur gear.
In the hobbing machine the additional provision of the pneumatic air gun blower which has the input from the main compressor line is used to remove the bur accumulated in the arbor. This reduces the misalignment in the seating position of the workpieces along with the flange which reduces the runout. In shaving machine for proper contact of work piece with flange, an increase in budding face is recommended. Thus it is concluded that by increasing the budding face of the right flange and left flange exact mating between the work piece and the flange will occur. This reduces the stress and the any misalignment between the work piece and the flange during machining process. The collet provided is a round collet which gives a firm grip to the work piece when the machining operation is done. The work piece when it is placed the strong gripping force of the collet makes sure there is zero movement during the machining operation of the gears. Thus using collet, the misalignment due to movement during the machining operation is arrested. And also the rejection of gears due to OBD runout is reduced by using the recommended solutions.

Aronu Ugochukwu et al [8] 2015 derived that This paper presents a low cost and flexible home control and environmental monitoring system. It employs an embedded micro – web server in Arduino Mega 2560 microcontroller, with IP connectivity for accessing and controlling devices and appliances remotely. These devices can be controlled through a web application or via Bluetooth Android based Smart phone app. The proposed system does not require a dedicated server PC with respect to similar systems and offers a novel communication protocol to monitor and control the home environment with more than just the switching functionality. To demonstrate the feasibility and effectiveness of this system, devices such as light switches, power plug, temperature sensor, gas sensor and motion sensors have been integrated with the proposed home control system.
In this paper, a novel architecture for low cost and flexible home control and monitoring system using android based Smart phone is proposed and implementation. The proposed architecture utilizes a micro web server and bluetooth communication as an interoperable application layer for communicating between the remote user and the home devices. Any Android based the Arduino micro-controller acts as a client and the PHP will act as a server (Wamp, IIS or Apache servers can be used) because PHP is a client based programming language.

Venkatesh Neelapala et al [9] 2015 says that Now-a-days air pollution is increasing rapidly due to growing cities, industrialization and higher levels of energy consumption leading to global warming and acid rains. To avoid such effects an efficient environment monitoring system is necessary. In this paper, an online environment monitoring system based on wireless sensor network using X-bee and open source hardware platforms, arduino and Raspberry pi is implemented.

Fig. 5 Arduino input method

Air pollution affects the health, survival or activities of many organisms including humans. Many of the world's largest cities today have poor air quality. To avoid such

adverse effects an efficient air pollution monitoring system is necessary. Wireless sensor networks (WSN) have been deployed for air quality monitoring. The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery. The proposed air quality monitoring system is implemented in different phases. The phases are sensors interfacing, Zigbee network formation, web server creation, services on internet.

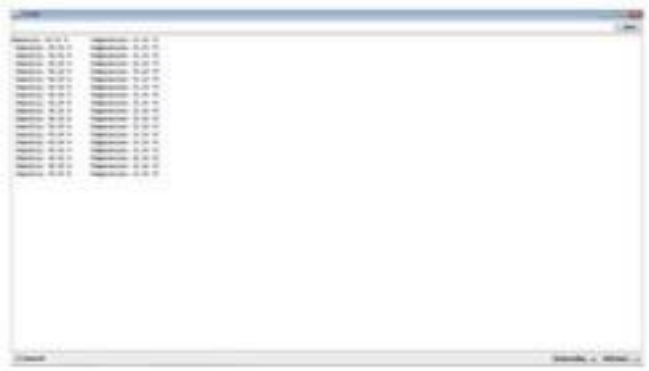

Fig. 6 Sensors reading on terminal

In this paper, we an environment monitoring system designed using Arduino, Raspberry Pi, XBee, and a number of open source software packages is implemented. Zigbee network is created using XBee and DHT11 sensor is interfaced to arduino UNO. Webserver is created on Raspberry Pi with wifi capability. Future work includes interfacing MQ135,MQ7 sensors to arduino UNO R3 and making the system online.

5. CONCLUSIONS

The main aim of the above study is to understand the nature of gear deburring and finishing. This completely automated and system integrated idea once developed has a lot of scope for the future development when it comes to automating the entire manufacturing line in the industry. Hence there is a rapidly growing market for this system in the future.

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