International Journal of Engineering & Technology, 7 (4.10) (2018) 443-447

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



Productivity Enhancement by Implementing Automatic Burr Cleaning Machine in Lathes

[*1] Vishnu.R ,[2] Raagav.R ,[3] Karthik.R ,[4] Thamaraiselvan.A, [5] Palani.S

[1,2,3,4,5]Department of mechanical engineering,VEL TECH MULTITECH,Avadi,Chennai-62,India
**Corresponding author E-mail: vishnu7raman@gmail.com*

Abstract

In the era of modernization and complete automation, industries employ manual cleaning operation which is highly time-consuming and man power requirements are high. To overcome this situation an automatic cleaning machine which can be employed to overcome the above stated obstacles by means of a completely automated cleaning system universally for different categories of machines based on the duties and classes of performance respectively.
The main objective of this project is to develop a universal cleaning system which is used to completely clean the wastes which falls in between the machinery and at its collection spots such as hoppers, beds, plates, floors etc., where it cleans in all places where human hands cannot reach and cleaning operation considered not possible. The major advantage of machines are that they much more precise in doing the work than considered to a human or manual labor

Keywords: *automation; breakdown maintenance; kaizens; productivity enhancement*

1. Introduction

In the age of automation, industrialization has evolved to another level were even small processes are carried out in a schematic procedure and various approaches are developed to reduce the time involved during production operation like timely working on the job, effective handling of the machines and the raw materials and of course the production procedure[1]. But it was noted that kaizens were not solved only prevented in maintenance and cleaning of the machined wastes and the problem which are formed in the machinery due to its unclean state, rather various root cause analyses done by the experts suggests an alternate method for production and considering the cleanliness factor negligible or not taken into consideration[9],[10]. Although many results regarding cleanliness factors of machinery has been published they have been management based and timely adjustments were required frequently.

1.1. Problem Definition

Much industrial related solution has been integrated but considering the periodic problem formed even after proper steps are taken. In maintenance engineering practices like preventive maintenance methods like six sigma, root cause analysis and predictive maintenance the machine cleanliness factors are nearly negligible or avoided to maintain the balance in the process procedure. But in the aspect of mechanical engineering major defects are caused due to the improper cleaning of the machines. The research work suggests a much more permanent solution [11] for the cleanliness factor of the machine rather than the temporary management methods and engineering methodologies [12] for timely maintenance procedure.

1.2. Universality Factor

Further the universality factor that is the machine fixation for any lathe is determined by trial and error method and by collection of data from the producer of different types of lathe machine.
And the machine further development would be for all types of conventional and non-conventional machines based on different classes of duty, types of operations performed by the machines and the different fixations involved, the Table 1 and the constraints for common dimension selections are shown in the below pages.

2. Ease of Use

2.1 Mechanism Involved

The system uses ball screw, where the nut of the screw is made of stainless steel and the bolt or the moving part is made of brass and turns between the nut and the bolt, A ball made of ceramic is employed which reduces the wear and the friction between the nut and the bolt. At the end of the screw the shaft of the motor is connected. For this case a low torque motor is used. To ensure clockwise and anticlockwise rotation of the screw, a circuit which has a time relay property is employed.

2.2 Working Process

The automatic cleaning machine is a combination of both electronic that is circuitry and mechanical component which is ball screw. The system uses ball screw, where the nut of the screw is made of stainless steel and the bolt or the moving part is made of brass and turns between the nut and the bolt, A ball made of ceramic is employed which reduces the wear and the friction be-

Copyright © 2018 Authors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

tween the nut and the bolt. At the end of the screw the shaft of the motor is connected.
The circuit used for the working of the machine is a time relay circuit a 555 relay delay timing circuit. The circuit's operation is divided into two halves one is used for successive frontal clockwise motion of the ball screw and other half is used for the recessive backward motion of the ball screw, the circuit is chosen because of its accurate time relay and delay purposes and is power efficient in effective handling of the low torque motor to ensure the free operating of machine.
The circuit is joined at the end of motor head for effective control of motor. The top of the body is designed in such a way that lubrication of the screw and the bolt is given with holes and a female plug end so that the brush can be joined by joining the male end present at the back of the brush.

3. Needs for the Machine

There were various analyses and research work is undertaken in the industries to reduce unwanted cleaning time in the industries which remain theoretical or proved not so useful to invest on. But based on the technical data there it is proved that machine failure or breakdown is caused due to improper maintenance activity [3],[4] and lack of cleanliness factor in the industrial environment[6],[7],[8]. For this very problem sated a cleaning machine is developed under scrutiny of various types, duties and classes of machines and their roles in industries have been analyzed tabulated and a common universal cleaning machine is developed to solve the man power required for cleaning operation done in the industries.
The machine is used to reduce the man power and separate cleaning time allocated and which can say increase the production time and can also reduce the machine breakdowns. The machine which stated above is initially developed one was used for cleaning burr produced and deposited in the bed of the lathe machine, considered the scope of the cleaning system was stated minimal. But the newly developed machine has overcome the previous obstacles.

3.1 Design Calculation

LIST OF SYMBOLS
Φ =pitch diameter
Ƞ = output efficiency
π = 3.14
μ =coefficient of friction
α = pressure angle
Calculation of Ball Screw:
w = 2N
(ISO metric standard)
Screw:
Diameter = 24mm
Poisson ratio = 0.15
p = 8mm
l = p = 8mm
Collar:
Outer diameter = 24mm
Inner diameter = 20mm
Poisson ratio = 0.12
Angle = 15 degree
Length = 350mm
To find power required to drive:
t = 5.74 N-mm
To find twisting product in collar:
(Mt) c = 2.64 N-mm
To find total twisting moment:
(Mt) t = 8.38 N-mm
Output efficiency:
Ƞo = 0.303
Ƞo = 30.38%
The output efficiency of ball screw is 30.38%. This percentage is for 100 rpm motor.

3.2. Prototype Design

Initial development of the prototype required a lot of ground work mainly assessing the dimensions and data collection of various processes including the stand or base dimensions and selection criteria of the common dimension of the stand, running tracks or guide track and the burr removing apparatus of the machine with space enough to hold the circuit for operations and to adjust time for the required sweeping operations.

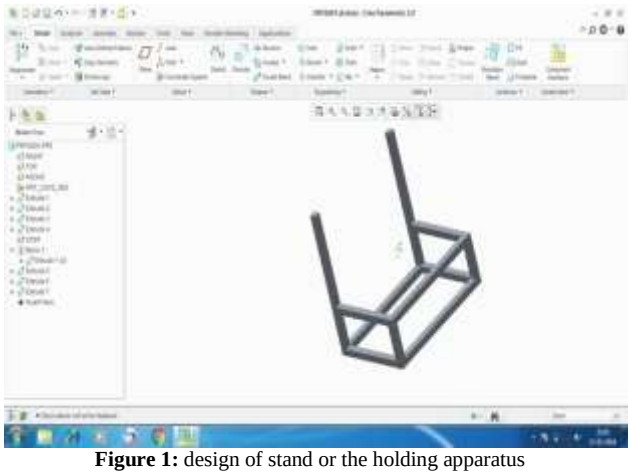


Figure 1: design of stand or the holding apparatus

Further the design of the burr cleaner was done say the length approximately 350-400 mm was taken and the brush diameter was also chosen and a different span of aluminum bar to hold the brush because of its flexible property is also taken into account the design is sown below

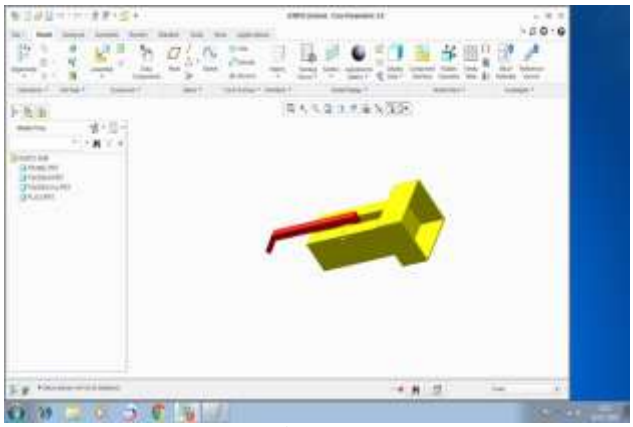


Figure 2: design of the burr cleaning setup

The setup is tested for uniform load distribution, time control and friction between the railing setup for the free motion of the machine travel.

3.3 Prototype Development

The prototype development begins with the process of material sourcing which would possess the following fatigue resistance, corrosion proof, sturdiness and of course cost efficient, raw galvanized aluminum coated sheet metal was brought of thickness 3mm and sheet metalling operations are done and bended and cut for specific dimensions and the steel rod are measured and cut and welded for joining to form a entirety of a stand and aluminum railings are measured, cut and assembled to form railing for the machine travel.

4. Results and Discussion

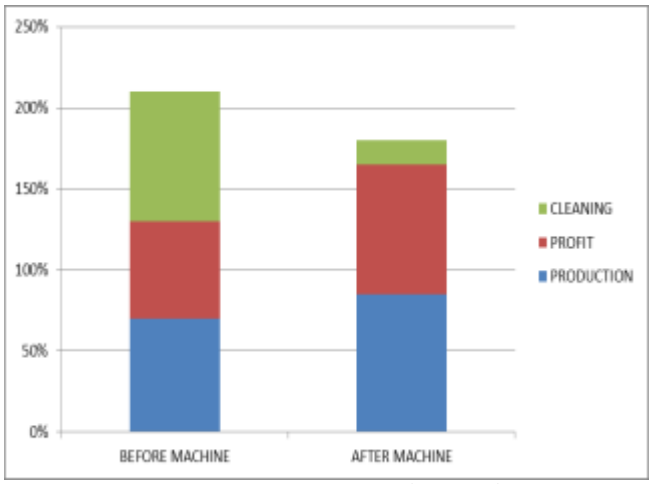


Figure 3: Result based on machine setup before and after installation

The Figure3 depicts that the productivity level is low and cleaning time allocation is high before the implementation of cleaning machine and after implementation the productivity level has increased and the cleaning time allocation is considerably reduced.
Further the image of the cleaning setup placed on the lathe without the stand is shown below the setup is an initial prototype.



Figure 4: Picture of the entire setup

The Figure2 depicts the setup of the entire machinery and temporary placement in the tool post of lathe machine when it is switched off.
Furthermore a height weight distribution of humans for the past two decade has been taken into account if the machine is to be carried stationary by humans who should be operated at ease and should not cause any fatigue for the user for a prolonged period of time.

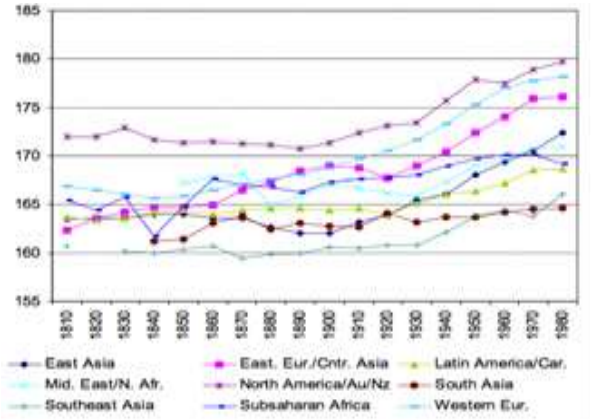


Figure 5: height weight distributions of the human beings for the past two decades

The Figure 5 is the line chart which is developed to compare the height and weight distribution for the millennia in order to create the machine with an equally supplied weight distribution factor for determining the portability of the machine respectively.
Then for the preliminary dimension selection for trial and error method was chosen to choose lathes of different classes and duties on which the burr cleaning machine can be deployed in any possible manner.
The trial and error methods depicts the best possible alternatives from the test case which would withstand or tolerate the working condition it is a logical approach rather than a mathematical one, the following tables 1 and 2 are some of the best results which are possible dimensions on which the burr cleaning machine can be employed.
The table consists of various dimension defining parameters such as table diameter, table width, length, tool post width, height etc., and machining time, cutting speed, spindle speed, manual automatic or CNC and their weight to be precise to determine the functionality of the burr cleaning machine under specific conditions respectively.
The trial and error method approach is adapted here because it gives more accuracy in selection of the choices than solving analytically each and every single dimensional criterion which narrows the choice of using the burr cleaning machine effectively than utilizing the machine for even one minimal significant purpose of cleaning a much more versatile part.



Figure 5: depicts the development of stand based on the tabulation of the list of values

5. Conclusion

The main objective of the work was to completely automate the cleaning process involved in conventional lathes and to increase the productivity and to eliminate the cleaning time in the industries, and theoretically a 20% of cleaning time was reduced per shift per machine which is higher and less time consuming than calculating preventive and predictive maintenance analysis instead of giving a practical solution which is permanent and less complicated to handle by the application of the cleaning machine.

Acknowledgment

The research work was funded by TNSCST.

References

[1] A. Garg, V.Vijayraghvan, K. Tai, Pravin M. Singru, Vishal Jain, Nikilesh Krishnakumar, Model development based on evolutionary framework for condition monitoring of a lathe machine,vol-8,pages 95-110,2015.
[2] Danilo de Jesus Oliveria and et al., improving minimum quality lubrication in CBN grinding using compressed air wheel cleaning journal of material processing technology 212, 2559-2568, 2012.
[3] C.Aurich and et al., Burrs-Analysis, control and removal, CIRP Annals-Manufacturing technology 58, 519-542, 2009.

[4] Zhaojun Kou and et al., Burr controlling in micro milling with supporting Material method, Procedia manufacturing, vol-1, pages 501-511, 2015.
[5] Niels deHoop, Joseph G. Massey and Chuck McKinney, A plywood veneer lathe maintenance expert system- development and implementation, Computers and electronics in agriculture, Vol-7, 23-33, 1992.
[6] B.C. Kwon, K.H. Kim, K.H. Kim, S.L. Ko, New abrasive deburring method using suction for micro burrs at intersecting holes, CIRP Annals- Manufacturing technology 65, 145-148, 2016.
[7] Chih-Hsing Chu and David Dornfield, Tool path planning for avoiding exit burrs, Journal of manufacturing process, vol-2, No.2, 2010.
[8] Sergey F. Golovashchenko, A study on trimming of aluminum autobody sheet and development of a new robust process eliminating burrs and slivers International journal of mechanical sciences 48, 1384-1400, 2006.
[9] Kiran M, Cijo Mathew, Jacob Kuraiakose, Root cause analysis for reducing breakdowns in a manufacturing industry, UETAE, vol-3, issue 1, 2013.
[10] Nicoleta Isac, Principles of TQM in automotive industry, Romanian Economic and Business review-vol5,No. 4, 2004.
[11] Chih-Hsing Chu, David Dornfield, Geometric approaches for reducing burr formation in planar milling by tool exits, journal of manufacturing process vol2, No.2, 2005.
[12] Vladimir Jesus Trava-Airoldi & et al., Hot filament scaling up for CVD diamond burr manufacturing, surface and coatings technology 77, 797-802, 1995.

Table 1: list of dimensions

S.NO	MACHINE NAME	CATEGORY	SPECIFICATIONS OF INDIVIDUAL MACHINERY						
			AXIS	WORK HOLDING DIAMETER	TABLE DIMENSIONS	TRAVEL DISTANCE	SPEEDS	POWER CAPACITY	WEIGHT
A	GEAR HOBBING								
1	GH 200	CNC	6 AXIS	200 mm	2702*3360*2870 mm floor Ø 40mm	200-550 mm (z Axis) 15-215 mm (x axis)	1500 rpm (hob speed) 230 rpm (table speed)	A.C 12/16 KW	9000 kg
2	LC 200	CNC	6 AXIS	180 mm	Ø 180 mm	540 mm	C.S 450 rpm	26 KW	16000 kg
3	LC 380	CNC	6 AXIS	320 mm	Ø 380 mm	320 mm	C.S 450 rpm	14-27 KW	16000 kg
4	LC 300	CNC	6 AXIS	250 mm	Ø200 mm	300 mm	C.S 450 rpm	14-27 KW	16000 kg
5	LC 500	CNC	6 AXIS	500 mm	Ø320 mm	200-300 mm	C.S 450 rpm	14-27 KW	16000 kg
B	GEAR CUTTING								
6	OFA 32 CNC 6	CNC	6 AXIS ±45 HELIX	320 mm	4213*3500*2800 mm Ø 300 mm	max/min 300/40 505/205	T.S 71-700 min^{-1}	12 KW	8000 KG
7	OFA 75 CNC 6	CNC	6AXIS ±45 HELIX	750 mm	4050*3530*3100 mm Ø 680 mm	max/min 580/60 850/220	T.S 25-450 min^{-1}	28 KW	13500 kg
8	OFA 100 CNC 6	CNC	6AXIS ±45 HELIX	1050 mm	4500*3530*3100 mm	max/min 625/80 850/220	T.S 25-450 min^{-1}	28 KW	14000 kg
C	GEAR SHAPING								
9	OHA 50 CNC 5	CNC	5 AXIS	800 mm	3500*2800*2950 mm Ø 500 mm	355 mm left 125 mm right	0-1900 mm-min^{-1} for circular 0-5000 mm-min^{-1} for radial	17 KW	7200 kg
	SLOTTING MACHINE								
10	VERTICAL TYPE DLS 6	CONVENTIONAL LIGHT DUTY	1 AXIS	N.M	250 mm	210 mm	3 SPEED 1 HP	1 HP	N.M
11	VERTICAL TYPE DLS 10	CONVENTIONAL LIGHT DUTY	1 AXIS	N.M	250 mm	330 mm	3 SPEED 1 HP	1 HP	N.M
12	VERTICAL TYPE DLS 8	CONVENTIONAL LIGHT DUTY	1 AXIS	N.M	330 mm	300 mm	3 SPEED 1 HP	1 HP	N.M
13	NORMAL TYPE DS 12 EH	MANUAL HEAVY DUTY	1 AXIS	400mm	500 mm	450 mm	C.S 20-54-80	3 HP	N.M
14	NORMAL TYPE DS 18 EH	MANUAL HEAVY DUTY	1 AXIS	500 mm	600 mm	560 mm	C.S 15-45-65-85	5 HP	N.M
15	NORMAL TYPE DS 24 EH	MANUAL HEAVY DUTY	1 AXIS	600 mm	750 mm	600 mm	C.S 15-45-65-85	5 HP	N.M
16	FULL AUTOMATIC DS 36 EH	AUTOMATIC HEAVY DUTY	3 AXIS	900 mm	1000 mm	700 mm	C.S 15-45-65-85	10 HP	N.M
17	FULL AUTOMATIC DS 40 EH	AUTOMATIC HEAVY DUTY	3 AXIS	1000 mm	1200 mm	750 mm	C.S 15-45-65-85	10 HP	N.M
18	VERTICAL TYPE DS 10	CONVENTIONAL HEAVY DUTY	1 AXIS	N.M	300 mm	380 mm	S.S 40-60 rpm	2 HP	N.M
19	VERTICAL TYPE DS 12 ECO	CONVENTIONAL HEAVY DUTY	1 AXIS	N.M	350 mm	380 mm	S.S 40-60 rpm	2 HP	N.M
D									
20	MILLING MACHINE ANIL MC 500	MANUAL	2 AXIS	200 mm	1175*225 mm	1000*225 mm	S.S 45-2000 rpm	spindle power 3 KW	table spec. 170 kg overall N.M
21	VERTICAL TYPE	CNC	3 AXIS	min 500mm	700*400 mm	X TRAVEL 700 mm Y TRAVEL 400 mm Z TRAVEL 300 mm	S.S 8000 rpm	spindle power 7 KW	N.M
22	DM 566 MM 5 CNC	CNC	5 AXIS	600*500mm	700*400 mm	600 mm	S.S 8000 rpm	30 HP 22.4 KW	N.M
23	KNEE TYPE VERTICAL	MANUAL	3 AXIS	>=800 mm	1520*310 mm	>=800 mm	C.S 1500 rpm T.S 36-1800 rpm	cutting power 5.5 KW	table wt. >=350 kg

Table 2: list of dimensions

E	ALL GEAR LATHES								
24	DL 300*500	MANUAL	1 AXIS	400 mm	3 FEET	300*500 mm 500 mm	S.S 40-1200 rpm	9 SPEED	250 kg
25	DL 340*700	MANUAL	1 AXIS	400 mm	1350 mm	700 mm 240 mm	S.S 40-1200 rpm	8 SPEED	550 kg
26	DL 350*1000	MANUAL	1 AXIS	400 mm	6 FEET	1000 mm 350*1000 mm	S.S 40-1200 rpm	8 SPEED	600 kg
27	DL 350*1500	MANUAL	1 AXIS	400 mm	7 FEET	1500 mm 350*1500 mm	S.S 40-1200 rpm	8 SPEED	700 kg
28	DL 400*1000	MANUAL	1 AXIS	800 mm	8 FEET	1500 mm 360*1500 mm 210 mm	S.S 40-1200 rpm	8 SPEED	850 kg
29	DL 360*1000	MANUAL	1 AXIS	600-800 mm	6 FEET	360*1000 mm 210 mm	S.S 40-1200 rpm	8 SPEED	900 kg
30	DL 360*1500	MANUAL	1 AXIS	600-800 mm	8 FEET	360*1500 mm 210 mm	S.S 40-1200 rpm	8 SPEED	1500 kg
31	DL 600*1000	MANUAL	1 AXIS	600-800 mm	9 FEET	600*1000 mm 1000 mm	S.S 40-1200 rpm	9 SPEED	1600 kg
32	DL 600*2500	MANUAL	1 AXIS	600-800 mm	12 FEET	600*2500 mm 600 mm	S.S 40-1200 rpm	9 SPEED	1800 kg
33	DL 400*1200	MANUAL	1 AXIS	600-1000 mm	2100 mm	400*1200 mm 280 mm	S.S 40-1200 rpm	8 SPEED	900 kg
34	DL 450*1000	MANUAL	1 AXIS	800 mm	1800 mm	450*1000 mm 225 mm	S.S 45-1200 rpm	8 SPEED	850 kg
35	DL 450*1200	MANUAL	1 AXIS	800 mm	2100 mm	450*1200 mm 225 mm	S.S 45-1200 rpm	8 SPEED	950 kg
36	DL 450*1500	MANUAL	1 AXIS	800 mm	2400 mm	450*1500 mm 225 mm	S.S 45-1200 rpm	8 SPEED	1050 kg
37	DL 500*1000	MANUAL	1 AXIS	800 mm	1800 mm	500*1000 mm 250 mm	S.S 45-1200 rpm	8 SPEED	900 kg
38	DL 500*1200	MANUAL	1 AXIS	800 mm	2100 mm	500*1200 mm 250 mm	S.S 45-1200 rpm	8 SPEED	1000 kg
39	DL 500*1500	MANUAL	1 AXIS	800 mm	2400 mm	500*1500 mm 250 mm	S.S 45-1200 rpm	8 SPEED	1100 kg
40	DL 600*1000	MANUAL	1 AXIS	600 mm	7 FEET	600*1000 mm 300 mm	S.S 40-1200 rpm	9 SPEED	1500 kg
41	DL 600*1500	MANUAL	1 AXIS	600 mm	9 FEET	600*1500 mm 300 mm	S.S 40-1200 rpm	9 SPEED	1600 kg
42	DL 600*2500	MANUAL	1 AXIS	600 mm	12 FEET	600*2500 mm 300 mm	S.S 40-1200 rpm	9 SPEED	1800 kg
	C.S- CUTTING SPEED								
	S.S- SPINDLE SPEED								
	T.S- TABLE SPEED								
	N.M-NOT MENTIONED								