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Parametric Optimization of force during turning Process on Mild steel

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Abstract: -- Minimizing power in any machining process is more important. As power is directly proportional to the force, the present work is aimed towards analyzing the force and optimizing it. Lathe is the oldest machine tool where it has more usage in the industrial applications. Therefore the present work is concentrated on Lathe.

The present work aims at optimizing the cutting parameters of turning operation for minimizing the force. In the present work design of experiments (Taguchi Analysis) is used for deciding the number of experiments. Nine experiments were conducted and using dynamometer force is calculated. A multiple regression analysis is carried out for the experimental data and derived an equation. Using this equation with the given inputs , cutting parameters are optimized for force minimization using genetic algorithm.

Keywords: Turning, Force minimization, Optimization of ctting parameters, Genetic Algorithm.

I. INTRODUCTION

Lathe is the most widely used and versatile machine tool, It can be named as the mother of all machine tools. It was the foremost machine tool that led to the invention of many other tools. The main function of this lathe is to remove metal from a work piece or specimen, to obtain required shape and size.

Lathe can be widely used for turning operation. The principle involved while turning is, the work piece or specimen is held rigidly in the chucks on the machine and then turned against the single point cutting tool, thus results in metal removal from the work piece in the form of chips. Besides turning Lathe can perform several operations like drilling, grinding, threading, boring, reaming etc.

However, there are different types of lathes available, the principle involved is same. The size of lathe can be specified by some of the specifications as given below: (i) Swing or Maximum diameter that can be rotated over the bed. (ii) Maximum length of the work piece. (iii) Bed Length (iv)Maximum diameter of the bar.

Dynamometer: It is a device used for measuring cutting forces, torque. It is also known as Machine tool dynamometer. With the emerging technologies, machine tool dynamometer's are rapidly used for optimizing the cutting forces and also for accurate measurement of forces. But these forces during operation are dependent on cutting speed, federate, depth of cut, geometry and also other factors like lubrication during machining. A turning dynamometer can measure static and dynamic cutting forces by using strain gauges.

The Dynamometer used for this project is shown in Fig 2. It is one of the cutting force measuring instrument. The sensor is designed in such a way that it can be rigidly mounted on the tool post, the cutting tool can be fixed to the sensor directly. This feature helps to measure the forces accurately. The main advantage involved in this is the tool bit can be grind to any angle required.

Fig 1 Representation of Lathe

Genetic Algorithm is an optimization and search technique. This is based on the principle of Genetics. It is evolved from "Darwin's" Theory. The basic concept of Genetic algorithm was first introduced by "John Holland". It is used as an optimal solution finder for finding optimal

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cutting parameters during the turning process. The main need of Genetic Algorithm is it is used in optimization of process parameters in advanced machining processes.

Fig 2: Dynamometer

II. LITERATURE SURVEY

Sujit Kumar Jha et al. [1] stated that in the competitive market the cost and quality of a product plays vital role to prosper in a manufacturing world. The cost of a product can be optimized by mass production and minimizing the waste. The maximum production rate can be achieved by using different optimization techniques like Taguchi analysis and analysis of variants (anova). It is observed that from annova analysis the depth of cut plays a significant role and feed is considered as less significant as iit doesn't effect MRR during turning operation.

M. Duvairaj et al. [2] proposed micro turning, a process by which micro components can be produced. The main equipment used is cnc micro turning of Inconel 600 alloy with Titanium. Microturning is carried out with certain standard measurements of speed (25,31 and 37 m/min), feed (5,10,15 mm/rev), DOC (30,50,70mm). For all these set of experiments the output parameters like surface finish, toolware are measured. Non-linear regression model is used to represent relationship between input and output variables. Optimization method i.e Genetic Algorithm is used to optimize the cutting parameters in turning process.

M Nataraj et al. [3] presented machining of hybrid metal matrix composite is difficult as the particulates are abrasive in nature. This results in vibrations and toolwear. An attempt was made in this experiment to evaluate thee machining characteristics of hybrid metal matrix and mathermatical model was developed mainly temperature for cutting condition while machining.

D Kanakaraja et al. [4] proposed metal cutting operations represent major parts of manufacturing operations in which turning plays a dominant role. Better cutting condition during turning gives good surface quality before machining starts. Optimization is also an important parameter in any process as economy of machining operation is also important. In this experimentation a CNC turning center is proposed for machining SAE8822 alloy steel work piece material with carbide cutting tool. However, Taguchi is used for finding optimized solution and anova is used for finding the influence of turning paramters.

Neeraj Saraswat et al. [5] proposed the main objective of any manufacturing industries is to produce high quality products with lower cost in short time. The selection of process parameters plays a vital role to enhance the quality. In this experiment the cutting parameters like Speed, feed, DOC have been optimized in turning of mild steel in turning operation. However anova is used to study the performance charachteristics in turning operation.

Lakwinder Pal Singh et al. [6] proposed hss tools are the most commonly used tools in small and medium scale industries. Tool life can be enhanced bby Cryogenic treatment. As compared to untreated hss tools performance of cryogenic treated hss tool is better. CT HSS tool exhibit better performance based on power consumed by Lathe in turning operation. Anova results shows that in CT HSS tool, feed rate is the most important parameter followed by cutting speed. But in UT HSS cutting speed plays a major role. It is observed in comparison with power consumption by the lathe CT HSS tool exhibits better results than UT HSS tools.

III. EXPERIMENTAL DATA AND ANALYSIS

INPUT DATA

Work piece used: mild steel (ms)

Cutting tool: High speed steel (hss)

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Table 1. Cutting parameters data

Feed (mm/rev)(X_1)	0.028	0.099	0.199
Speed(rpm)(X_2)	54	770	1200
DOC(mm) (X_3)	0.5	1	2

Multiple Regression Equation:

It is used for validation. It is an extension of Simple Linear Regression. The general purpose of multiple regression is to know about the relationship between independent and dependent variables.

Y= -57.37 + (0.1094) X1 + (2240) X2 + (97.5) X3

Table2:Experimental results force output

Exp No	Speed	Feed	DOC	Fx	Fy	F
1	135	0.049	0.5	14.4	9.8	17.42
2	135	0.099	1	24	13.5	27.54
3	135	0.199	1.5	50	25	55.90
4	325	0.049	1.5	16	11	19.42
5	325	0.099	0.5	19	12.4	22.69
6	325	0.199	1	47	24.4	52.96
7	770	0.049	1	17.5	11.1	20.72
8	770	0.099	1.5	38	27	46.62
9	770	0.199	0.5	41	32	52.01

Table2 represents experimental results force output.

Table3:Experiments using Taguchi analysis.

S.No	Speed	Feed	DOC	Objective Function value
1	54	0.028	0.5	58.007600
2	133.595	0.028	0.5	66.790933
3	348.673	0.028	0.506	90.875229
4	54	0.028	0.5	58.007
5	104.842	0.028	0.503	64.045
6	323.778	0.028	0.5	87.798
7	144.448	0.028	0.5	68.54
8	94.859	0.028	0.501	63.66181
9	54	0.028	0.5	58.00760
10	149.946	0.028	0.503	68.9628
11	298.884	0.028	0.5	84.9627

Table3 represents design of experiments using Taguchi analysis.

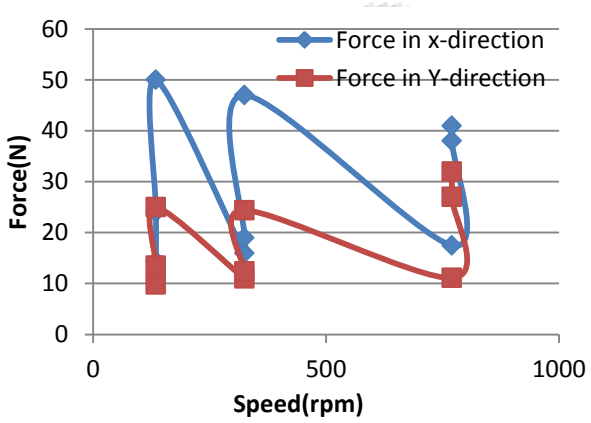

Fig 3:Speed Vs Force in X& Y directions

Sample graphs considerering speed and fore are shown in Figure 3 and 4.

Figure 3 presents the graph between speed(rpm) and force(N) in X-direction and Y-direction.In the X-direction force is minimum (14.4N) at speed (135 rpm), and maximum force (50N) at speed (135rpm). In the Y-direction force is minimum (9.8N) at speed (135 rpm), and maximum force (32N) at speed (770 rpm).

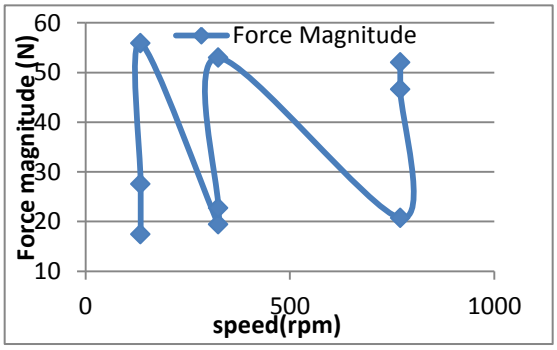

Fig 4: Speed Vs Force magnitude

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Figure 4 presents the graph between speed(rpm) and force magnitude(N). force magnitude is minimum (14.4N) at speed (135 rpm), and maximum force (55.9 N) at speed (135rpm).

IV. CONCLUSION

Dynamometer attached to the traditional lathe is used for force measurement. (Design Of Experiments) Using Taguchi analysis experiments were carried out. Force is analyzed using attached dynamometer. As force is proportional to the power, minimizing the force is an objective for the present work. A multiple regression analysis is carried out with the considered cutting parameters. Using the multiple regression equation as the objective function, force is optimized using genetic algorithm technique. The best optimized speed is 54 rpm, feed is 0.028 mm/rev, depth of cut as 0.5mm with minimized force as 58 N.

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time. Problem arise when need of some medicine is urgent and drug stores are not open or drug is not available in stock, especially during night time. In remote areas, rural areas and places where public turnover is less, the availability of medicines within the patient's reach is a critical issue. These are some of the main problems that are being faced by the society in present scenario. ATM will help in solving these problems by providing the medicines 24x7.

OBJECTIVE

The objective of the project is to develop a system to deliver medicine 24x7 to the people. The machine can deliver mainly Over The Counter(OTC)drugs, pain killer, first-aid products etc., so it will be very useful to the society. Medicine dispensing process is done in four steps.

1. Authentication of registered user.
2. Selection of required medicine.
3. Payment.
4. Collection of requested medicine.

First the user needs to register in a particular authorized center with prescribed drugs. Then user will be provided with RFID Tag and password. During transaction user must first swipe the card Request for the required medicine should be made by the user by scrolling through the menu

displayed on the screen. The machine will search for the requested medicine in dispenser. If the medicine is present in the machine, then the payment has to be made for the requested/available quantity of the medicine. Finally, the medicine is collected.

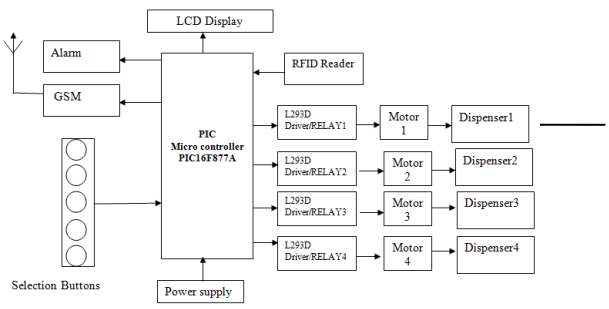
LITERATURE SURVEY:

This chapter explains existing problem that the society is facing. Under medicines legislation, General Sale List (GSL) medicines (i.e., those that may be purchased from ordinary retail outlets such as supermarkets) may be sold or supplied from a vending machine. Life will become a little easier with an innovative vending machine that dispenses medicines. Users will be able to get basic Over-The-Counter (OTC) medicine at any time (24x7). Minor illnesses have a strange way of inviting people in the middle of the night when pharmacies are already closed. Over-the counter (OTC) drugs are a class of medicines sold directly to a consumer without a prescription from a health care professional, as compared to prescription drugs, which may be sold only to consumers possessing a valid prescription. People will able to access the medicine with the help of this machine even at the night time. With this, first aid can be provided in time to the user. Medicines sold or supplied from a vending machine should satisfy the condition laid down by the Medical Council of India. Medicines which these restrictions apply are mainly aspirin and paracetamol. Products containing these substances should not exceed 16 tablets in a package for sale.

SOFTWARE REQUIREMENTS

- Embedded c
- MPLAB IDE
- CCSC Compiler

BLOCK DIAGRAM



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HARDWARE REQUIREMENTS

- Microcontroller PIC16F877A
- LCD - 16 x 2
- RFID Reader
- GSM MODEM
- Medicine Dispenser
- Motor
- L293D Driver
- 7812/ 7805 voltage regulators for power supply
- Power supply circuit

TECHNICAL SPECIFICATIONS:

Operating voltage of embedded circuitry is 5VDC . Current consumption of device in active mode approx.200mill amp@ no load and approx.1000mill amp@ full load Operating frequency of device is 20 MHZ

ADVANTAGES:

It's very much Portable that it can be installed in very less area.
No Individual person needed for maintenance.
Easy to use.
Provides 24/7 medicine facility.
Since online transaction involved no fear of robbery.
Since disease name and relevant medicine will be stored in the database, the user will have to mention the disease name. The dispenser will dispense the medicine automatically for that disease.

APPLICATIONS:

- The concept is very much useful in day to day life for common people.
- This can be implemented everywhere such as shopping malls.
- It can be implemented on National Highways.
- It can be installed in Railway stations

CONCLUSION

From this concept we are conclude that, the automatic medicine vending machine is technically feasible to the peoples. It is based in PIC micro-controller provide GSM service. It gives availability of medicines all the time, also in rural areas. it is very helpful. It gives ease of access also. It is sales person-less service which is based on smart card.

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