Review on Advance Automation of Conventional Lathe Machine

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***Abstract* — now a day, products can be produced by modern technology, which uses computer software, hardware and firm ware in industries. It is needed to use CNC lathe machine to get more accurate dimensions and irregular shape. So, CNC machines are becoming more and more important in modernized industrialization. There are many conventional lathe machines in our country. To build a new modern developed country, it is required to convert these conventional lathe machines into semi-automatic control lathe machine by retrofitting. Developing and changing into semi-automatic control lathe machine, there are three required portions, namely, mechanical electronics and hydraulic. In this project we convert the convention lathes which have 5ft bed length in to the semi-automatic lathe. In mechanical side we replace the ball screw in place of lead screw for better accuracy and remove some unnecessary component like gears for providing space for motors. We add an extra plates or structure for installation of motors. Also provides a hydraulic circuit for coolant. In electronic side we used a servo/ stepper motor for both Z and X axis and provide controller for the efficient operation.**

***Keywords*—Automation, Retrofitting, CNC Turning Center**

I. INTRODUCTION [7]

Retrofitting refers to the addition of new technology or features to older systems this definition gives an almost all information about the word retrofitting. When we say that retrofitting related to some component that mean we try to upgrade that component and improve their efficacy through a present technology. But here we only talks about the retrofitting in lathe machine at time Retrofitting is the process of replacing the CNC, servo and spindle systems on an otherwise mechanically sound machine tool to extend its useful life. Rebuilding and remanufacturing typically include a CNC retrofit. The anticipated benefits include a lower cost investment than purchasing a new machine and an improvement in uptime and availability. But there are often other unanticipated benefits to retrofitting including lower energy costs, higher performance and a new level of manufacturing data accessibility.

Justifying the retrofit investment is similar to any other kind of investment. Considering all the financial costs and benefits allows you to calculate an ROI for a comparison with other investment opportunities. By considering all the financial and non-financial benefits associated with the project, you will be able to decide if the retrofit makes sense for your business. Assuming the machine tool is generally in good shape mechanically, CNC retrofitting is typically the lowest cost solution to improve the overall performance of an older machine tool. Though some electrical subassembly is often performed at the retrofitter's business location, most of the work can be completed at the machine site, avoiding costly machine rigging and transportation costs, and minimizing the time that the machine is out of commission. Rebuilding typically includes the repair or replacement of some worn mechanical components such as ball screws, lubrication pumps, safety interlocks, guards, hoses, belts and electrical wiring. The rebuild is typically performed at the rebuilder's facility, so there may be additional transportation and rigging costs.

Remanufacturing goes a step further to repair or replace mechanical components to the original, as new, factory specification. It is likely that the machine will be completely disassembled, cleaned, inspected, repaired and painted. All pneumatic, hydraulic and electrical systems will be updated. The machine may also be modified or have mechanical accessories added to re-purpose it for a new application. Practically without exception, remanufacturing will take place at the remanufacturer's site. Deciding whether to retrofit, rebuild or remanufacturer depends on the current condition of the machine and the anticipated benefits from the investment. Reviewing maintenance records and part yield statistics may help understand the state of the machines mechanical systems. A ball bar analysis can also be used to diagnose mechanical problems. Retrofit, rebuild and remanufacturing companies will also be able to evaluate the current condition of the machine and recommend the appropriate solution.

The main objective of the retrofitting in lathe machine is to improve the existing conventional lathe machine to provide it features of CNC machine with very lower cost than the new CNC machine.

Rather than above main objective there also several objectives of the retrofitting which is given below

- To Increased productivity and improved control of machine.
- Far superior repeatability.
- To reduced machine downtime.
- Fast machining cycles.
- High accuracy, high feed-rate.
- To increased accuracy and part finished due to controller.

- User friendly programming and simulation software enables 3D graphic representation of job with automatic generation of G-Code.
- Eliminate additional tooling cost.
- The Up-gradation Package is less expensive and more readily justifiable.

II. LITERATURE REVIEW

In 1984, Department of Mechanical Engineering, IIT, New Delhi [1], has taken a research topic named as "Machine tool failure data analysis for condition monitoring application". With the development of modern manufacturing technology, Flexible Manufacturing Systems have become key equipment in factory automation. Machine tool is heart of the Flexible Manufacturing Systems. Ex example Lathe machine is the general type of machine tool used by almost all the FMSs. During the operation of this machine tool, different kinds of failures are faced by the industry. A systematic study of such failures can help in identifying the critical sub-system of these machine tools. This will be useful for identifying the condition monitoring needs of the machine tools. This deals with the identification of critical sub-system based on the failure data analysis for different type of machine tools.

Initially lathe has been classified into various sub-systems as shown in Figure. In the frequency of failures for each sub-system and failure modes have been considered for finding out the weakest sub-system. In analysis, failure frequency and downtime have been taken into consideration for deciding critical sub-systems of machine tools. It can be observed that the maximum failures took place in headstock and carriage sub-systems. These sub-systems face failures in components like gear, gearbox bearing, spindle bearing, clutch and cross-slide jib. Here it could be observed that the bearing failures cause longer downtime.

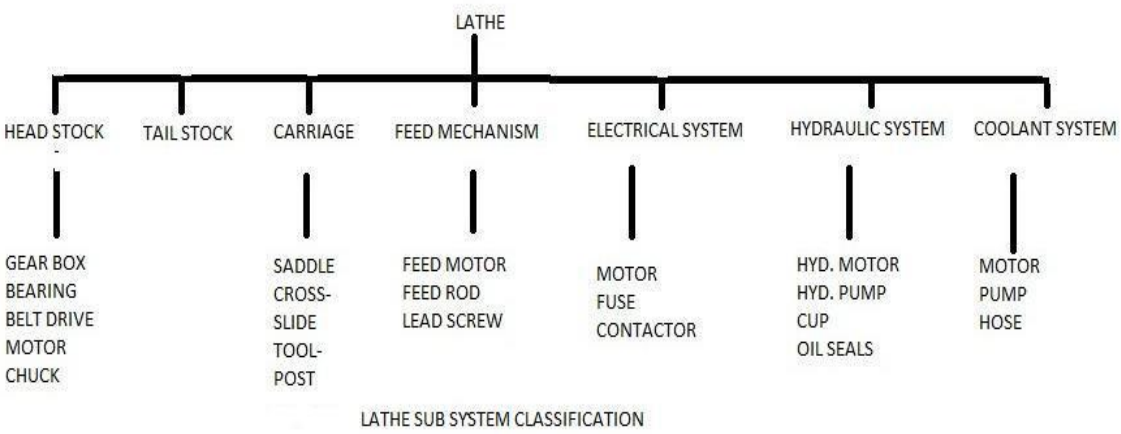

Figure 1: Wearing Parts of Conventional lathe

On histogram different failure modes and their relative failure frequencies have been grouped into four-failure modes, component damage, fuse burnt, circuit fault and looseness. It can be observed that the dominant failure mode is because of component damage. The components are electrical, electronics and of mechanical categories.

In 2013, V. Roy & S. Kumar [2] from J institute Engineering, India published development of Lathe machine attachment for CNC machine. He has developed attachment for an existing CNC machine. The CNC machine operates on mechatronic controls and a computer interface called CAMSOFT, and is used as a CNC Lathe after installing the respective attachment to it. He has design the attachment using CAD software & fabricated different model. He has susseccfully design & fabricated the model. The working of the CNC Lathe attachment is tested & checked by making proper machining operation like turning and thread cutting. The machining operations are successfully done. The CNC machine becomes multifunctional with the presently developed lathe attachment and can be used accordingly by installing the respective attachment to it. The CNC machine is useful for research work in both the fields, when installed with the proper attachment. The figure of developed attachment is shown below,

Figure 2: Developed attachment

Developed design is successfully implemented in the proposed work for the development of the lathe attachment including headstock, tailstock and tool post. The work shows the process of the conceptual design and use of proper process planning for the development of the different components of the lathe attachment. The previously attachment and developed lathe attachment make the CNC machine multifunctional. Thus further research can be carried out in both the fields respectively. The CNC machine is based on the mechatronic controls and the computer interface CAMSOFT. Various lathe operations like plain turning, step turning, taper turning, arc turning, threading operations and manufacturing of a bolt are successfully performed on the CNC machine, when installed with lathe attachment. The successful development of the lathe attachment for the CNC machine is done.

In 2005, Kriangkrai Waiyagan & E.L.J. Bohez [3] from Department of Design and Manufacturing Engineering, Asian Institute of Technology, Thailand has published titled as Intelligent Feature Based Process Planning for Five-Axis Lathe. The main objective of his paper is to propose a new machining feature model focused on 5Dmachining features. The machining features describing a Prisronal part, which includes both prismatic and rotational features, are introduced. The model is not only taking into account geometric entities, manufacturing aspects but also including machining processes and knowledge-based rules for intelligent process planning system of five-axis lathe. Geometric entities are specified by defining feature parameters corresponding to the shape of feature. Manufacturing aspects include properties of blank part, settings up and technological data like tolerances and surface finishing. Machining processes and knowledge based rules attached with each feature are used as constraints to guide the system for automatically selecting suitable machining operations. Finally the pilot implementation of machining features for operation selection is demonstrated. The figure shows design configuration of five axis lathe machine.

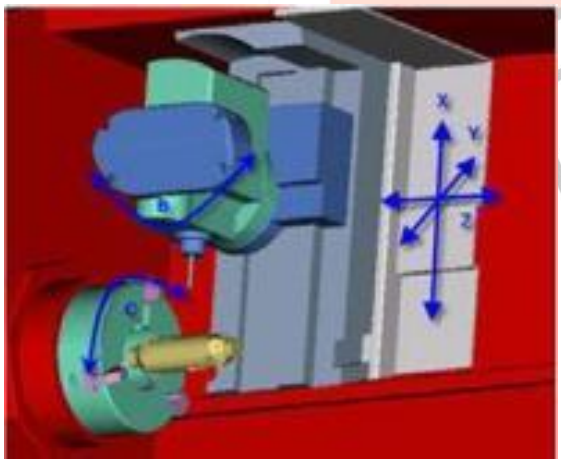

Figure 3: Configuration of five axis lathe

Figure 4: Configuration window

The Prisronal parts can be machined completely both milling and turning processes in a single setup on a five-axis lathe totally including X, Z, C, B and Y axis. The feature concept is attractive approach to provide appropriate product definitions. In the beginning, the hierarchical tree structure of machining features classified by numbers of machining axis was presented. Also, a new machining feature definition model taking into account geometric entities, manufacturing aspects, machining processes and knowledge based rules was proposed. Next, a portion of 3D & 5D-machining features attached with machining processes and a knowledge based rule for five axis lathe was illustrated. The system allows a user opening a CAD file (STEP format) to identify features of the work piece by following the machining features in the library. The user has to give needed parameters manually to the system.

In 2008, Department of Mechanical Engineering, University of Auckland [4] researched on special issue on recent advances in flexible automation. Flexible automation has taken on many new concepts, technologies and practices. This evolution process has resulted in numerous new terminologies in replacement of flexible automation. The ultimate goal remains - empowering the modern industry with different "versions" of automation technologies in order to meet the ever-diverse and ever-changing market. There are twelve articles included in this special issue. They can be grouped into three categories, (1) New Advances at the CNC Front, (2) Advancement in Automation Hardware, (3) Intelligent Scheduling in FMS. Flexible Automation as a topic of research has been around for at least a half century.

1. Over the many years, most of the flexible automation systems have Computer Numerically Controlled (CNC) machine tools as the principal manufacturing equipment. G-codes have been extensively used by the CNC machine tools for part programming and are now considered as a bottleneck for developing next generation CNC machines. Data model represents a common standard specifically aimed at the intelligent CNC manufacturing workstation, making the goal of a standardized CNC controller and NC data generation facility a reality.
2. Hardware development for automation systems has not stopped and will perhaps never. There are three papers in this issue discussing some of the advancements related to automation hardware, e.g., Automatic Guided Vehicles (AGVs), Master Slave Manipulator and flexible machining of non-cylinder piston pinhole. This type of FMS aims at high production efficiency by self-controlling or decentralizing the plan, design and operation of a FMS.
3. A decentralized optimization method for production scheduling, transportation routing for AGVs and motion planning for material handling robots has been developed. The system consists of a process agent that creates production schedule, AGV agents to generate collision free routing for multiple AGVs, and a handling agent that determines motion planning for material handling system.

In 2013, Karl-Heinz Schumacher [5] is invented about Multi Spindle Lathe. Multi spindle lathe comprising a machine frame as spindle drum which is arranged in the machine frame is rotatable about a spindle drum axis and is made up at least partially of segments which are cut out from flat material in a stacking direction parallel to the spindle drum axis and extend in stacking planes transverse to the stacking direction these segments having receiving cutouts and cooling channel cutouts which overlap with one another such that the spindle drum has spindle motor receptacles for spindle motors and a cooling channel system separated there from by wall webs characterized in that the cooling channel system has several channel subsystems for a liquid cooling medium Which are fed in parallel.

In 2013, M. Moses & Dr. Denis Ashok [6] M. Tech, Mechatronic from School of Mechanical and Building Science, VIT University, Vellore, India published titled as Development of a new machining setup for energy efficient turning process. In the production unit, lathe is one of the important protection machines. This paper focuses on producing a quality product in lathe machine with less power consumption. In order to achieve that, a special setup is developed in the lathe machine for turning and finishing of the components, to achieve quality product and also to improve the productivity. As a result of this new approach, profuse amount of energy can be saved, quality product can be obtained and tool life can be increased. The study aimed at evaluating the best process environment which could simultaneously satisfy requirements of both quality and as well as productivity. By conducting many experiments it was found that this special setup process improves the quality and also reduces the power consumption as compared with the existing process. Figure of developed attachment as shown below,

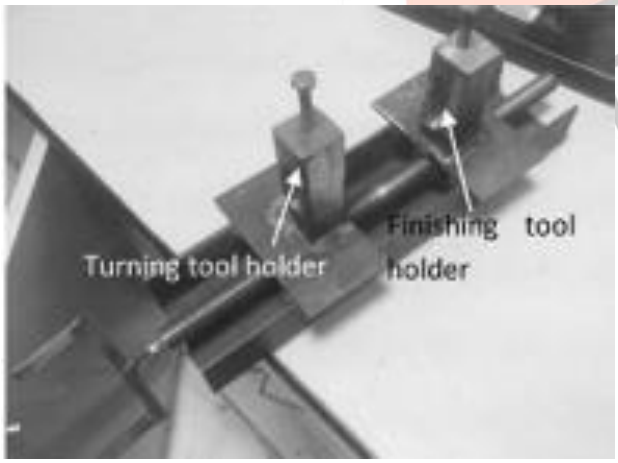

Figure 5: Machine set up

Figure 6:Running set up

He has concluded that the addition of surface finish tool in turning process helps to improve the surface finish and this setup increases the tool life of the turning tool. From the experimental results, it is confirmed that there is no change of power consumption even after the additional usage of surface finish tool. Hence, the set up will be helpful in improving the quality product, with lesser load and power consumption.

III. CONCLUSION

By developing automation in conventional lathe machine by retrofitting stepper based method, the machine works as CNC trainer for teaching, learning of the student subject. Also Cost of machine is minimizes approximate 4 times below the original CNC trainer.

As automation new developed retrofitted lathe is done by replacing or removing the components from conventional lathe machine, therefore setup cost is high as compare with standard lathe machine but production rate is too much high. So it is very useful for mass production.

The accuracy of the job manufactured in retrofitted lathe machine is also high so repeatability and dimensional stability of manufactured part is achieved. At last some complex job which is not manufactured in conventional lathe machine can be manufactured in new developed retrofitted lathe machine.

REFERENCE

[1] Machine Tool Failure Data Analysis for Condition Monitoring Application Department of Mechanical Engineering, Indian Institute of Technology, New Delhi. Kegs. R. L., On-line Machine and Process Diagnostics, Annals of the CIRP. , 32(2), 469-473, 1984.

[2] V. Roy • S. Kumar from Inst. Eng. India Ser. C(April–June 2013) 94(2):187–195 DOI: 10.1007/s40032-013-0064-2

[3] Kriangkrai Waiyagan & E.L.J. Bohez from Department of Design and Manufacturing Engineering, Asian Institute of Technology, P.O. Box 4, Klong Luang, 12120 Pathumthani, Thailand Ninth International Conference on Computer Aided Design and Computer Graphics (CAD/CG 2005) 0-7695-2473-7/05 $20.00 © 2005 IEEE

[4] Special issue on Recent Advances in Flexible Automation, International Journal of Innovative Computing, Information and Control Volume 4, Number 3, March 2008 - ICIC International °c 2008 ISSN 1349-4198Department of Mechanical Engineering, University of Auckland, Private Bag 92019, Auckland, New Zealand.

[5] Karl-Heinz Schumacher (2013), Multispindle Lathe. US patent # 2013008702/2013

[6] In 2013, M. Moses & Dr. Denis Ashok M. Tech, Mechatronic from School of Mechanical and Building Science, VIT University, Vellore, India 978-1-4673-6150-7/13/$31.00 ©2013 IEEE

[7] http://en.wikipedia.org/wiki/Numerical_control

[8] http://en.wikipedia.org/wiki/Lathe

[9] http://www.epa.gov/ozone/title6/609/technicians/retrguid.html