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REVIEW ON REAL TIME CONTROL OF LATHE MACHINE DURING TURNING OPERATIONS

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Abstract— In present days lathe machine is very useful in various industries in various operations like turning, machining, cutting, threading, knurling etc. Although lathe machines are very economical but now a day, CNC (Computer Numeric Control) took place of conventional lathe machine. But some changes make lathe as useful as CNC machine, which is useful either for skilled operators or unskilled operators. This conversion from conventional lathe to semi-automated lathe is basically done by retrofitting. In this project we used variable frequency derive, microcontroller, sensor to control the speed, and made lathe semi-automatic. In this we give input in the form of speed with the help of mobile phone or keypad. We can say we make lathe semi-automatic on IOT(Internet of Things) based, which provide high accuracy, high productivity and reduce set up cost as CNC machine has high set up cost.

Keywords— Automation, Retrofitting, Variable Frequency Drive, microcontroller and IOT.

1. INTRODUCTION

Lathe which is known as one of the oldest and precious machine tool became a part of every manufacturing industry. It came into existence from the very early tree lathe which was then a novel device for rotating and machining a piece of work held between two adjacent trees. [1] The Lathe can be defined as a machine tool which holds the workpiece between two rigid and strong supports which called Centres, or in a Chuck or face plate while the latter revolves. But today's scenario it is necessity of the production industry to modify the conventional lathe or we can say the conversion of lathe machine in to semi-automatic lathe machine. Although we find a large number of modern Machine Tools, most of them Automatic too, still the Lathe maintains its existence as an indispensible Machine tool even today. It still proves to be vital a necessity in all modern Tool rooms, Repair shops and Training workshop. The main significance of the lathe machine lies in the variety of its applications in the manufacturing of different types of product. As a single job will need a number of other operations on different machine tools for performing different operation. The utility of Lathe, even in modern advanced industry, can, therefore, be easily recognized. [2]
Retrofitting is defined as the process in which some modification has been done in the existing device or machine with the help of some new technology or processes as shown in fig.1. When the retrofitting is related to some device or component then it is said that we upgrade that device or component and increase the efficiency and accuracy of that component through a new technology. The conversion of conventional lathe machine into semi-automatic lathe machine is a demand of today's competitiveness. Retrofitting also justify the investment with the another type of investments.

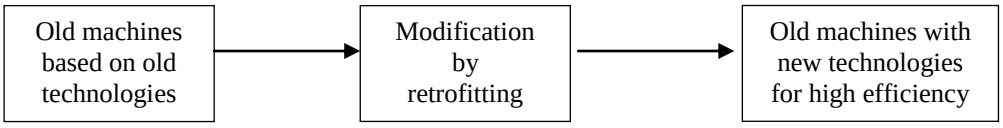

Figure.1. Flow diagram for retrofitting [3]

This retrofitting objective gives following advantages over the existing machine

- To increase productivity and increase control of the machine.
- High accuracy.
- Reduced machining time and operating cost.
- Operated by both unskilled and skilled operator.
- To increase part finish and accuracy due to controller.
- Cost effective due to less expensive in comparison to CNC

2. LITERATURE REVIEW

Flexible manufacturing system became key equipment in industry automation, under the development of modern manufacturing technology. The various types of machine tools are the heart of flexible manufacturing system for example the lathe machine is the basic type of machine which is used in every process of the manufacturing system. During various type of operation different type of tool failure occurred in the industry so a brief and systematic investigation helps in identifying the failure occurred during the operation. This will help in identifying the necessities of

the condition monitoring of the tools. The identification of various type of sub-system based on failure data analysis of different machine tools is easy. **[4]**

2.1. Papers on automation of lathe machine

Swami and Kumar [5] used a bed for the analysis of dynamic load and static load. They reduced the weight of the bed without compromising its structural qualities like rigidity and accuracy. They use CATIA software for 3D modelling with the help of HYPERMESH. They analysed it with the help of ANSYS software. In this way they reduced the weight of the bed structure up to 16.1kg which reduced the manufacturing cost of the lathe.

Kaisan Muhammad Usman [6] verified the different rack angle used for different machining operation of mild steel with constant relief angle and high speed, so that the time and cost of tool regrinding will reduce. He concluded that 20˚ rake angle give longer tool life which automatically reduced the machining cost and increased efficiency of the lathe machine.

Veeranjaneyulu and Hari Babu [7] focused on the analysis and designing of gear in the gearbox system when they transferred power at different speeds. Generally the gear box made by the cast iron and cast steel materials but they manufactured the gear box by aluminium so that the weight will reduce. All the stress and displacement analysed by COSMOS software, which is a part of solid works. The weight of the aluminium reduced to 3 times in respect of alloy steel, so that the mechanical efficiency will increase.

Devarakonda Harish Kumar [8] focused on the surface finish of the machined part. For this he attached a cylindrical grinding part by low cost method for getting fine surface finish. The grinding wheel made by aluminium oxide abrasive and mounted on the ball bearing after removing tool post. The grinding wheel is driven with the help of AC motor. This experiment increases the surface finish, corrosive resistance and fatigue strength. With the help of this attachment the power loss also reduced.

Shiva Kumar et al [9] design and analysed the spindle speed made by alloy steel with the help of ANSYS software. In this experiment they use ball bearing with definite stiffness for zero vibration or no resonance. They design the lathe spindle for reducing the deflection value up to 24 mm and bearing span 0.096021 mm. In this way they reduce vibration up to minimum level.

Parmar et al [10] [11] in this research paper author convert manual lathe machine into semi-automated lathe machine with the help of replacement and addition of some parts. They developed a semi-automated lathe machine based on stepper method. In this project they automated a 5 ft. bed long manual lathe into semi-automated lathe machine by keeping three portions (mechanical, hydraulic and electronic) in their mind. They replaced the ball screw in place of lead screw. An extra plate used for the installation of stepper motor. As some parts are replaced and some required parts like motor, extra plate, lead screw, hydraulic circuit added the set up cost increased in comparison of standard lathe machine. This set up is very useful for mass production as the production rate is high.

Desai et al [12] carried a research on pumping systems. The pumping system utilized about 20% of the total electrical energy of world consumption. In this research work two different methods, MATLAB simulations and experimental work carried out to control the flow of Pump. As the flow of pump is control by throttling, net head of motor increases and for controlling this motor drawn extra power. So author use VFD (Variable Frequency Drive) system which reduces the flow and due to this motor consume less power. While starting a motor VFD drawn very less power also the stopping of motor made smoother. This also increase power factor.

Kumara and Mohan Ram [13] modified the fixture of lathe machine used for brake drum. Fixture, as we know is used to hold supports the workpiece also it locates the workpiece but did not guide the tool. There are several problems like (1) zero gap (2) buttons used etc. so that it is difficult to machine the bore of brake drum. So they-design a new fixture with pads in place of Buttons, and provide space/gap so that the tool moved freely inside the brake drum. In design and manufacturing of lathe fixture they use mild steel having standard ISO 9001. By this new fixture of lathe it is more comfortable to run this and it will reduce the fatigue of operator as well as machine bed. The pad thickness further reduced so that balancing is high.

Sharma et al. [14] used resistance strain gauge in place of mechanical gauge for finding the relationship between different cutting parameters and forces. The resistant strain gauge is capable in measuring the forces during working operation. After experiment they concluded that the feed and cutting forces are directly proportional to the feed and depth of cut.

Krishnamoorthy et al. [15] investigate the effect of various parameters on the surface finish and material removal rate during the machining operation of SS304 austenitic steel. They came to a conclusion that surface finish is affected by the spindle speed, feed rate and depth of cut. As these parameter decreased the surface finished increased and as these parameter increased material removal rate increased.

Pagar et al. [16] convert conventional lathe machines into semi-automatic control lathe machine by the process of retrofitting. In this method they kept focus on three portions, (1) mechanical (2) electronic (3) hydraulic. They replace some unnecessary parts like gears and add an extra structure or we can say a plate for installing a motor. They choose stepper motor from the standard AC motors like brushless motors or stepper motor. This motor is suitable for both Z and X axis and provides efficient control for the operation. They check all the required specification like operating speed and time, positioning distance and time, resolution, position holding, stopping accuracy. This increased the speed which is required in production of various parts, better dimensional accuracy, and increased efficiency to produce complex parts.

Abhishek et al. [17] in this research, author make a brake component, it needs a computerized numerical control, which is very costly compared to a conventional lathe. We can't achieve the target manually in lathe due to large need of components by traditional machining process. In place, as the target has been achieved within time with using this robotics and flexible manufacturing tooling. So the conventional lathe machine made semi-automatic by implementing this control and Automation, we can achieve Just in Time concept and also increase the productivity. This process also reduces the problem of availability of skilled labour. So they automated a lathe machine using pneumatics to make it economically.

Raut et al. [18] the researcher made the modification of heavy duty lathe machine used for the manufacturing of butterfly valve body. The basic operation in butterfly valve body manufacturing is drilling on heavy duty lathe, which is frustrating for operator. To improve the operator comfort, the toggle clamp is used to fir the positive of tailstock on lathe bed instead of lacking screw. To move the tailstock over bed, the pneumatic cylinder attachment is used instead of manual pulling or pushing. This improved the productivity of manual lathe and less expensive as compared to the existing CNC (Computer Numeric Control) or NC (Numeric Control) machines.

Khandait and Vanalkar [19] optimize the two parameters- machine tool vibration and work piece roughness. Surface finish is a major issue in machining operation. For better surface finish it is necessary to control the vibration so they give the guidelines to the operator. The problem is being analysed by FFT (Fast Fourier transform) analyser. In this they analysed that maximum stress during turning operation occurred at chuck.

Sakthi et al. [20] convert the conventional/manual lathe machine which is very economical into the semi- automatic lathe machine by using soft computing method. In this they developed a software program with the help of Solid works software and deploy it on the hardware Arduino UNO and Arduino IDE (software). In this research they used various component to make lathe semi-automatic for example: they used (1) motor in both (vertical and horizontal drive) form for depth of cut, leadscrew movement/rotation, (2) Rectifiers for converting the AC voltage into DC voltage, (3) transformer for lowering the voltage, (4) relays as a switch, (5) diode as low value resistor, (6) microcontroller for controlling the motor in depth and feed drive etc. After calculating all the parameters like forces (tangential, radial, and axial), power required and work done etc. they generated software program/coding with the help of "Arduino Software IDE". This coding further evaluated/compiled for zero error or error free. After this it transferred to the Arduino board with the help of USB (Universal Serial Bus) cable. The workpiece help in the Arduino lathe and the machining process will start. After completing the process Arduino reset and next program will installed.

Yanto et al. [21] focused on the surface finish during turning and cutting operation. It is essential to choose the correct parameters for better surface finish. They used 600 rpm spindle speed, feed rate 130 m/min and 1.5 mm cutting depth for smooth surface finish. They also suggested the parameters for the rough surface finish. In this way they increased the tool life which reduced the manufacturing cost.

2.2. Papers on three phase induction motors and VFDs

Vishv Mohan [22] this paper shows the results when power transmission and distribution has been done at lower frequencies then this condition is favourable for conserving the energy. VFDs help to make power transmission at low frequency so that the energy saved from losing due to transmission and power distribution. There are various benefits of using VFDs like power saving, reduction of wear and tear of the motor.

Lingawar and Ingale [23] this research paper proposes a new concept for controlling the speed of the three phase induction motor by using variable frequency derive. The feedback device is used for giving the feedback to the drive to control the speed of motor. In this project the existing DC system of batching loom system was replaced by AC system. The starting sequence and load for main motor drive was formulated by variable frequency derive and a reference was generated for speed. The speed of the three phase induction motor was controlled with in limit by the reference which was generated with the feedback system. This work helps in the industry for reduction in the breakdowns, reduce the cost of maintenance, labour cost and also it increases the ability of batching role.

Shrike et al. [24] in this work the researcher made headway the use of semiconductor technology with the help of microcontroller for controlling the speed of induction motor easier. The variable frequency adjusted the user expound value of speed of the induction motor. The authentic speed and mentioned speed was equated and the dissimilarities were altered by modifying the ejecting angles of IGBTs (Insulated Gate Bipolar Transistor).

Augustine et al. [25] in this paper the authors made use of variable frequency drive to regulate the speed of three phase squirrel cage motor. The execution was done by mentioning an inverter and a rectifier, where the stimulating pulses were obtained by utilizing PIC micro controller for shifting the IGBTs of the diverter. The speed manipulation was made possible up to 0 to 630 rpm and manipulated by holding trim port. The programming of flow code builds the implementation much undemanding and the approachability towards PIC was moulded much appropriately. This technique for controlling the speed of motor has received a broad range of utilization in manufacturing industries. Keeping the torque persistent, the speed has been fluctuated from zero to contemporary speed.

M. Deepa [26] this paper give an idea for controlling the speed of a three phase induction motor by fabricating variable frequency drive. As we know the energy saving is very important now a day, so the variable frequency drive was wielded with PWM (Pulse Width Modulation) method for worthy control of motors. It leads to the best performance and high efficiency of the induction motor. In past two years the shortage of electricity leads the world towards saving unwanted energy. In the manufacturing industries where the motor and pumps are used where we modify the system by using V/F method for saving energy. With this we use timers for higher safety and safe guarding measure in opposition to sudden jerk in voltage and current also.

Raichurkar and Jamadar [27] in this paper the speed control procedures were extremely important in versatile speed drive technique which entailed inconstant voltage and frequency supply, got from a source diverter. The pulses whose width inflection technique was used to obtain fluctuating frequency and voltage supply from a diverter, but the space vector pulse width inflection has favourable condition such as uncomplicated digital recognition, effective DC bus applications over the techniques of pulse width inflections. In this a MATLAB/SIMULINK model was used for controlling the speed of the three phase induction motor by utilizing space vector

3. CONCLUSIONS

The following conclusions are drawn after reviewing the above mentioned literature:

1. With the help of small changes or modification we convert conventional lathe machine into semi-automated lathe which provide high accuracy rate, high production rate, and high repeatability, reduce set up cost, reduce machining time etc.
2. Retrofitting convert the useless machine into useful machine and it also increase the efficiency of the machine. In case of lathe the efficiency will increase so that the replacement of the lathe will reduce.

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