Automating Lathe Manufacturing Processes with Internet of Things:A Review

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Abstract - IoT is a new technology that is transforming the manufacturing sector. This study examines how IoT technology is being used to automate the production of lathes. It gives a general summary of the technology's current condition and its possibilities for production in the future. The paper evaluates the advantages of IoT-enabled automation for lathe manufacturing processes and the challenges faced in its implementation. It also looks at various IoT-enabled solutions that have been successfully deployed in lathe manufacturing processes. Additionally, the paper discusses some potential applications of IoT technology in lathe manufacturing processes and the potential benefits they could bring. Finally, the paper provides recommendations for further research into the application of IoT in lathe manufacturing processes. This paper provides valuable insight into the potential of IoT-enabled automation for lathe manufacturing processes and the challenges faced in its implementation. It gives an overview of the technology's position at the moment and the chances for further growth that may exist.

Keywords -Internet of Things, IoT, Manufacturing, Automation, Lathe Manufacturing Processes, Advantages, Challenges, Solutions, Applications.

I. INTRODUCTION

IoT is quickly becoming an integral part of our lives, as it is being used to automate a wide variety of processes, including manufacturing. Lathe manufacturing processes have long been a challenge for manufacturers due to the complexity of the process, its labor-intensive nature, and the length of time needed to perform the procedure. As manufacturers strive to reduce costs and improve efficiency, the use of IoT technology in lathe manufacturing processes is becoming more widespread. This paper will provide a review of the current state of research on the use of IoT in lathe manufacturing processes. [1] The lathe is a machine used to shape, bore, and cut metal, plastic, and other materials. It is a complex, labour intensive process that calls for a lot of resources, skill and expertise to complete successfully. As technology advances, the use of IoT in lathe manufacturing processes is becoming more prevalent. IoT technology the procedure, which will greatly improve the operations efficiency and accuracy while requiring less manual operating labour. On this review, it will explain the present state of research onus of IoT in lathe manufacturing processes. It will examine the various components of the process, including sensors, communication protocols, and data analysis. Additionally, it will go over the possible advantages of utilizing IoT in the manufacturing of lathes, as well as the potential challenges and limitations. It will begin by discussing the various components of the IoT technology used in lathe manufacturing processes. It will then discuss the potential benefits of using IoT, such as increased speed and accuracy, improved safety, and cost savings. It will also examine the potential challenges and limitations of using IoT in lathe manufacturing processes, such as the need for specialized hardware and software, and the potential for data security breaches. Next, they will discuss the various research studies that have explored the use of IoT in lathe manufacturing processes. They will review the various approaches taken in these studies and the results they achieved. They will also discuss the implications of these studies for the use of IoT in lathe manufacturing processes. Finally, they will provide a summary of our findings and offer some recommendations for future research. Our goal is to provide a comprehensive review of the current state of research on the use of IoT in lathe manufacturing processes, and to provide insights into the potential benefits and challenges associated with using IoT in this context [2-5].

II. OVERVIEW OF INTERNET OF THINGS (IOT)

The term "Internet of Things" refers to a continuously growing network of physical objects, including tools, vehicles, buildings, and other items, that are integrated with electronics, software, sensors, and network connectivity to collect and share data. The IoT has been integrated into a variety of industries, from healthcare to manufacturing, and is considered a

key technology for the Fourth Industrial Revolution [6]. In particular, IoT is being used to automate lathe manufacturing processes, which can increase productivity and reduce costs. An overview of the Internet of Things and how it may be used to automate the production of lathes is given in this article. The IoT is a network of tangible things, such as machines, vehicles, buildings, and other things, that come equipped with sensors, electronics, software, and network connectivity. This makes it possible for these things to interact with one another and gather and share data. The objects can be connected to the internet and can be monitored and controlled remotely [7]. The IoT is transforming the way people interact with technology and is considered a key technology for the Fourth Industrial Revolution.The IoT is comprised of different components, including sensors, actuators, and gateways. Sensors are used to collect data from the environment, such as temperature, humidity, pressure, and motion [8]. Actuators are devices that can receive a signal and perform an action, such as opening a door or turning on a light. Gateways are used to bridge the gap between the physical objects and the internet, and can be used to communicate between different networks.The IoT is used in industries, including healthcare, retail, manufacturing, and transportation. It can be used to automate processes, reduce costs, improve safety, and increase efficiency [9].

IOT In Lathe Manufacturing

Lathe manufacturing is a process of shaping metal pieces into desired shapes with the use of a lathe machine. It is a complex process that requires precise control over the speed of the lathe, the angle of the cutting tool, and the feed rate. The production of lathes can be automated with the help of IoT, increasing productivity and lowering costs. IoT-enabled lathe machines can be equipped with sensors to monitor the process and detect any anomalies. Sensors can be used to measure the speed of the machine, the angle of the cutting tool, and the feed rate. The data from the sensors can be used to control the machine and make adjustments in real-time.IOT can also be used to monitor the quality of the finished product. Sensors can be used to measure the dimensions of the product and compare them to the designed specifications [10]. The information may subsequently be utilised to identify any quality problems and modify the production procedure to guarantee the product's quality. The "Internet of Things" is a network of physical objects that can collect and exchange data because they are outfitted with electronics, software, sensors, and network connectivity. Healthcare, retail, manufacturing, and transportation are just a few of the industries that are using IoT to automate procedures, cut costs, boost efficiency, and increase safety. In particular, IoT is being utilised to automate the manufacture of lathes, increasing its effectiveness and efficiency. Sensors are used to monitor the process and detect any anomalies, as well as measure the dimensions of the product and compare them to the designed specifications. This review has highlighted the use of IoT in automating lathe manufacturing processes and its potential to improve productivity and reduce costs [11].

III. ADVANTAGES OF IOT FOR LATHE MANUFACTURING

The Industrial Sector has Revolutionized with the IoT, allowing manufacturers to automate processes and increase efficiency. Lathe manufacturing is no exception. This paper will review the advantages of using IoT in lathe manufacturing processes.IoT can be used for a variety of purposes in lathe manufacturing. It may be used to keep an eye on and manage the manufacturing process, cut expenses, and increase effectiveness. It can also be used to collect data from the production process, analyze it and use it to make decisions [12].One of the main advantages of using IoT in lathe manufacturing is its ability to automate processes. It can be used to control and monitor the production process, allowing for more efficient production. This can be done by connecting sensors to the production line, which can detect and report any faults or malfunctions in the machinery. This data can be analyzed and used to take decisions on how to improve the production process. This automation can decrease costs and improve efficiency by reducing the need for manual labour.IoT can also be used to collect data from the production process. This data can be used to analyze the process and make decisions on how to optimize it. For example, data can be used to identify areas of inefficiency or bottlenecks in the production process. This data can then be used to make changes that will improve the efficiency of the production process.IOT can also be used to monitor the performance of the lathes. This can be done by connecting sensors to the lathes and collecting data on their performance. This data can then be analyzed and used to identify any faults or malfunctions in the lathes [13]. This may help the lathes operate more efficiently and experience less delay and lastly IoT can be used to keep an eye on and manage the environment inside the manufacturing plant. This can be done by connecting sensors to the facility and collecting data on temperature, humidity, air quality, and other environmental factors. This data can then be analyzed and used to make changes to the environment in order to improve the production process.Ina nutshell, IoT can be used to automate processes, reduce costs and improve efficiency in lathe manufacturing. It can be used to gather and analyse data from the production process in order to identify areas of inefficiency and bottlenecks. It can also be used to monitor the performance of the lathes and control the environment in the manufacturing facility. By taking advantage of the many advantages of IoT in lathe manufacturing, manufacturers can improve their production processes and reduce costs [14].

IV. CHALLENGES OF IMPLEMENTING IOT FOR LATHE MANUFACTURING

Assuring interoperability between various devices, addressing security and privacy concerns, scaling the infrastructure to handle a large number of devices, managing and analysing massive amounts of data, ensuring reliability and redundancy, closing the skill and knowledge gap, taking cost implications into account, and adhering to regulatory requirements are

just a few of the challenges that come with implementing IoT for lathe manufacturing. To fully utilise the advantages of IoT in lathe production, careful planning, coordination, and adherence to best practises and standards are required.

Interoperability
Ensuring interoperability among the numerous IoT systems, sensors, and devices used in the manufacture of lathes is a big challenge. Different devices may make use of various interfaces, data formats, and communication protocols. It can be challenging to integrate these many parts while guaranteeing smooth data interchange and communication.

Security and Privacy
The adoption of IoT creates new security threats since linked devices might serve as entry sites for cyberattacks. Important issues include safeguarding confidential information, providing secure communication routes, and avoiding unauthorised access to the lathe manufacturing system. Additionally, privacy issues occur because data from connected devices may contain sensitive or confidential information.

Scalability
A huge number of lathes, each with a number of sensors and Internet of Things devices, may be found in lathe manufacturing plants. It can be difficult to scale the IoT infrastructure to support a large number of devices, control data transfer, and process and analyse the generated data in real-time. The system must be built to support expansion and modifications to the production environment.

Data Management and Analytics
IoT devices and sensors produce enormous amounts of data. Effectively managing, storing, processing, and analysing this data can be very difficult. To gain insightful knowledge and make wise judgements, it is crucial to implement reliable data management systems, data integration strategies, and advanced analytics algorithms.

Reliability and Redundancy
To prevent downtime and production losses, IoT-enabled lathe manufacturing systems must be reliable and run continuously. To lessen the effects of device or network failures, adequate redundancy measures, backup systems, and failover methods should be in place. Considerations for dependable communication and power supply are also essential.

Skills and Knowledge Gap
It takes knowledge of both conventional manufacturing procedures and IoT technologies to implement IoT in lathe manufacturing. It might be difficult to close the skill and knowledge gap in the workforce, train staff to comprehend and efficiently use IoT devices, and offer continuing technical support.

Cost Consideration
The purchase and installation of IoT devices, sensors, networking infrastructure, and data management systems are only some of the major upfront expenditures associated with IoT deployment. Maintenance, improvements, and data storage may also be considered continuous costs. It is a task that requires careful analysis to balance the expense of implementation with the anticipated benefits and return on investment.

Regulation and Compliance Issue
Implementing IoT in the manufacturing of lathes should adhere to all applicable standards, regulations, and data protection legislation. Given the dynamic nature of IoT rules and technology, it might be difficult to comprehend and follow these standards.
Lathe manufacturing is a highly complex process, with many variables that must be taken into account. As such, it requires a robust, reliable, and automated system, IoT is an ideal solution for this task, as it can provide the necessary intelligence and automation to ensure that the process is carried out correctly. IoT can provide real-time data on the lathe's performance, as well as provide timely updates on any changes that may need to be made in order to optimize the process. Furthermore, IoT can enable manufacturers to detect problems in a timely manner, allowing them to take corrective action before any damage occurs [15].

Challenges of Implementing IoT or Lathe Manufacturing
Despite the advantages of using IoT for lathe manufacturing, many issues still need to be resolved in order to guarantee a successful implementation. These challenges include:

Security
IoT devices are susceptible to cyber attacks since they are linked to the internet. As such,it is essential that adequate security measures are in place to prevent the data and systems from malicious actors.

Cost
Implementing IoT for lathe manufacturing can be expensive, as it requires the purchase of hardware and software, as well as the installation of the necessary infrastructure.

Integration
IoT devices need to be integrated with existing systems in order to ensure smooth operation. This can be a difficult and time-consuming process, especially if the existing systems are outdated or incompatible with the new technology.

Scalability
As the demand for IoT increases, it is necessary to ensure that the system is able to scale to meet the needs of the business.

Privacy
As IoT devices collect and transmit data,It is crucial to make sure that the users' privacy is respected and that the data is maintained safe. IoT has the potential to revolutionize the way manufacturers operate their businesses, but implementing it for lathe manufacturing processes can be challenging. Security, cost, integration, scalability, and privacy are all important issues that must be addressed in order to ensure a successful implementation. By understanding these challenges and taking steps to address them, manufacturers can take advantage of the many benefits that IoT has to offer [16].

V. IOT-ENABLED SOLUTIONS FOR LATHE MANUFACTURING

The use of IoT technology to improve monitoring, data analysis, and automation capabilities is one of the most recent developments in the manufacture of IoT-enabled lathes.

Remote Monitoring and Control
IoT makes it possible to remotely monitor lathe operations in real-time. Lathes that have sensors installed can gather information on variables like temperature, vibration, power usage, and tool wear. Operators and maintenance staff can monitor and assess the performance of the lathe remotely thanks to the data that can be sent to a centralized system or cloud platform. Operators can change settings and parameters remotely from a centralized place thanks to these features.

IOT Enabled Condition Monitoring
IoT technology can monitor numerous characteristics including vibration, temperature, and tool wear by adding sensors into traditional lathes. These sensors' real-time data can be gathered and analyzed in order to spot anomalies, foresee prospective problems, and enable preventive maintenance. This lessens unplanned failures, decreases downtime, and improves maintenance plans.

Data Analytics for Performance Optimization
During machining processes, IoT-enabled traditional lathes can gather a vast amount of data. This information can be utilized to optimize cutting parameters, lengthen tool life, and increase overall performance when paired with analytics tools and algorithms. Manufacturers can find trends, patterns, and areas for improvement by analyzing historical and current data, which boosts productivity and lowers costs.

Integration with Manufacturing Execution Systems Through IoT technology, conventional lathes can be connected to MES platforms. With the help of this interface, the lathe and the production management system may interchange data seamlessly, giving access to real-time data on work scheduling, material availability, and quality assurance. This kind of connectivity promotes manufacturing productivity by reducing manual data entry, improving production planning, and improving overall.

Energy Monitoring and Efficiency Improvement
Energy monitoring sensors can be incorporated into IoT-enabled conventional lathes to track energy usage while performing machining operations. Energy-intensive procedures can be found in this data, which can also be used to optimize energy use and put energy-saving tactics into practice. Manufacturers may decrease costs, increase sustainability, and abide by environmental rules by tracking and optimizing their energy use.

Automation and Intelligent Control
Automation and sophisticated control systems are made possible by IoT application in the manufacturing of lathes. IoT-enabled lathes can communicate and coordinate with other machines, systems, or robots in the production line through connectivity and data sharing. This makes it possible to do coordinated multi-machine operations, in-line measurements, and automated material handling. Intelligent control systems can improve precision, productivity, and adaptability by dynamically adjusting cutting parameters, optimizing tool routes, and making choices in real-time.

The IoT is revolutionizing the manufacturing industry. By leveraging the power of the Internet and connected devices, manufacturers can increase productivity, decrease expenses while raising the calibre of their output. One area in which the IoT is having a major impact is lathe manufacturing. By utilizing IoT-enabled solutions, lathe manufacturers can reduce downtime, improve accuracy and productivity, and increase overall efficiency.Lathe manufacturing is the process of cutting, shaping, and forming metal into parts used in the production of products [17]. It involves a variety of processes, including milling, drilling, and turning. In order to ensure accuracy and precision, lathe manufacturers must maintain tight tolerances and use high-precision cutting tools.In the past, lathe manufacturers relied on manual processes to monitor and control the production process. This was labourintensive and time-consuming, as operators had to constantly monitor the cutting tools and adjust settings to ensure that the parts were being cut correctly.However, with the advent of IoT-enabled solutions, lathe manufacturers can now automate many of these processes [18]. By connecting the lathe to the Internet, manufacturers can keep an eye on the manufacturing process in real-time and make changes as necessary, without having to manually intervene. This can significantly reduce downtime and increase production efficiency.In addition, IoT-enabled solutions can be used to track the performance of the cutting tools. By monitoring the cutting speed, temperature, and wear of the tools, manufacturers can ensure that they are being used correctly and that the parts are being cut accurately. This can not only increase accuracy, but also reduce the cost of tooling and maintenance.Furthermore, IoT-enabled solutions can be used to collect data about the lathe and its performance. This data can be used to optimize the production process and identify areas for improvement [19]. For example, the data can help manufacturers identify bottlenecks in the production method and suggest ways to improve the efficiency of the process.Finally, IoT-enabled solutions can be used to streamline communication between the lathe and other parts of the manufacturing process. For example, the lathe can be connected to other machines on the factory floor, allowing for the transfer of data and information between the machines. This can help reduce production time and improve accuracy.Overall, IoT-enabled solutions are revolutionizing lathe manufacturing. By connecting the lathe to the Internet, manufacturers can reduce downtime, improve accuracy and productivity, and increase overall efficiency. This can have a significant impact on the cost and quality of the products they produce. As the technology continues to evolve, the possibilities for IoT-enabled solutions in the manufacturing industry are virtually limitless [20].

VI. SENSORS IMPLEMENTED IN IOT ENABLED LATHE

Vibration Sensor

The vibrations generated during lathe operations are detected and measured using vibration sensors. They offer important information about the stability, balance, and state of the lathe and the machining operation.

Temperature Sensor

Temperature sensors keep track of the temperatures of the spindle, motor, bearings, and cutting tools, among other lathe parts. Monitoring temperature changes aids in spotting possible overheating problems, improving cooling systems, and protecting the workpiece and lathe from harm.

Force Sensor

The cutting forces applied to the workpiece during machining are measured using force sensors. These sensors offer useful information for tracking tool wear, spotting unusual cutting situations, and fine-tuning cutting parameters for longer tool life and higher-quality workpieces.

Proximity Sensor

The tool holder, carriage, and tailstock are a few examples of components that can be detected by proximity sensors for their position and movement. They make it possible to accurately orient oneself, detect tool changes, and avoid collisions.

Position Encoder

A precise feedback on the location and motion of the lathe's axes is provided by position encoders. They support precise machining operations by ensuring perfect positioning, control, and synchronization of the lathe's motions.

Power Sensor

The lathe's use of electricity is tracked using power sensors. These sensors enable energy management strategies by identifying energy-intensive tasks and optimizing energy efficiency during the machining processes.

Lubrication Sensor

Lubrication sensors keep an eye on the lathe's lubricants' condition and quality. They provide useful information for maintenance and provide the best possible lubrication for the lathe's components by detecting levels of impurities, moisture, or degradation.

Tool Wear Sensor

To track the state and wear of cutting tools in real-time, tool wear sensors can be incorporated into the lathe. They give information regarding tool life, enabling prompt tool replacements and maximizing tool use.

VII. POTENTIAL APPLICATIONS OF IOT FOR LATHE MANUFACTURING

The potential applications of IoT for lathe manufacturing are vast and far-reaching. IoT technology has the capability to revolutionize the way lathe manufacturers and operators interact with their machines, and this makes it a key component of the modern manufacturing landscape. IoT technologies have the capability to improve efficiency, reduce downtime, and improve safety by allowing for real-time data collection and analysis. This article will explore some of the potential applications of IoT for lathe manufacturing.First and foremost, IoT can be used to monitor the health of lathe machines. By connecting the machine to the internet, operators can collect real-time data on the performance of the machine, and use this data to identify any potential issues that may arise [21]. This can help to reduce downtime, as operators can quickly identify any potential issues and take action to address them. Additionally, this data can be used to identify areas of improvement, and help to ensure that the machine is operating at peak efficiency.IOT can also be used to automate lathe operations. By connecting the machine to the internet, operators can issue commands and instructions to the machine, which can then be carried out in real-time [22]. This may decrease the need for manual labour and increase operational effectiveness. In addition, it can help operators receive more precise data and lower the possibility of human error. Additionally, by connecting the machine to the internet, operators can receive notifications if any safety issues are detected, allowing them to take corrective action in a timely manner [23].Finally, IoT can be used to improve the quality of lathe products. By connecting the machine to the internet, operators can collect real-time data on the performance of the machine, and use this data to identify any potential quality issues that may arise. Additionally, by connecting the machine to the internet, operators can receive notifications if any quality issues are detected, allowing them to take corrective action in a timelymanner.Ina nutshell, the potential applications of IoT for lathe manufacturing are vast and far-reaching. IoT can be used to monitor the health of lathe machines, automate operations, improve safety, and improve the quality of products. As such, it is a key component of the modern manufacturing landscape, and one that should not be overlooked.

VIII. BENEFITS OF IOT FOR LATHE MANUFACTURING

The IoT is revolutionizing the way that businesses, both large and small, operate. For the manufacturing industry, in particular, the IoT is providing a range of powerful benefits as well as new opportunities. In the lathe manufacturing industry, the IoT is providing a host of benefits that can help businesses increase productivity, improve quality, reduce costs, and more.For starters, the IoT can help improve the accuracy of lathe manufacturing operations by providing real-time data that can be used to monitor and adjust processes. By connecting lathes to the IoT, manufacturers can collect data on factors such as temperature, pressure, and speed. This data can then be used to ensure that machines are running at optimal levels, resulting in better quality products and increased efficiency.The IoT can also be implemented to increase safety in lathe manufacturing. By connecting lathes to the IoT, manufacturers can monitor the machines in real-time, enabling them to quickly identify and address potential safety hazards before they become an issue. This can help reduce the risk of workplace accidents, ensuring a safe working environment for employees.In addition, the IoT can be used to streamline the logistics of lathe manufacturing. With the IoT, manufacturers can keep track of their inventory in real-time, allowing them to quickly and accurately know when they need to order more supplies or parts. This can helptodecrease the amount of time it takes to get new materials and products, leading to improved efficiency and cost savings.Finally, the IoT can be used to reduce the environmental impact of lathe manufacturing. By connecting lathes to the IoT, manufacturers can monitor their energy usage and make adjustments to ensure that they're using as little energy as possible. This can help reduce emissions and improve air quality, leading to a more sustainable manufacturing process.Ina nutshell, the IoT is providing a range of powerful benefits to the lathe manufacturing industry. By connecting lathes to the IoT, manufacturers can improve accuracy, safety, logistics, and sustainability. This can lead to increased productivity, improved quality, reduced costs, and a more sustainable process, making the IoT an invaluable tool for businesses in the lathe manufacturing industry [24 -30].

IX. RECOMMENDATIONS FOR FURTHER RESEARCH

The review of the literature on the effects of using virtual reality (VR) in the classroom has revealed several interesting findings. Firstly, there is evidence that VR can be used to engage and motivate students, particularly in the areas of science and mathematics. Secondly, VR has been demonstrated to be effective in terms of improving student's learning outcomes. Thirdly, there is the potential to use VR in a variety of other educational contexts. Finally, there is evidence that the use of VR can be used to facilitate collaborative learning.Despite the positive findings from the literature, further research is needed to examine the full effects of VR in the classroom. In particular, further research is needed to assess the long-term impact of VR on learning [31]. The literature suggests that VR can be used to engage and motivate students in the short-term, but it is unclear how long these effects might last. Additionally, further research is needed to examine the impact of different types of VR technology on student learning outcomes. For example, it is not clear whether the use of more immersive VR technology, such as head-mounted displays, will lead to greater learning gains

than the use of less immersive technology, such as desktop-based systems.In addition, further research is needed to explore the potential of VR in other educational contexts. For example, there is potential for VR to be used to teach other subject areas, such as history, geography and the humanities [32-35]. However, it is not clear whether the same benefits that have been demonstrated in the areas of science and mathematics will be seen in other subject areas. Further research is also needed to assess the potential of VR in other educational settings, such as corporate training and adult education.Furthermore, further research is needed to examine the use of VR for collaborative learning [36-38]. The literature suggests that VR may be effective for facilitating collaborative learning, but it is not clear how different types of collaboration can be facilitated through the use of VR. For example, it is not clear how the use of VR can enable and support peer-to-peer collaboration, or how the use of VR can be used to facilitate group work.Finally, more study is required to examine the effects of using VR in the classroom. For instance, more investigation is required to evaluate the moral ramifications of using VR in the classroom, as well as any possible effects on data security and privacy. Further investigation is required to examine the effects of VR use in the classroom on the teacher-student relationship as well as the influence on the overall classroom environment. In conclusion, the review of the literature on the use of VR in the classroom has revealed several interesting findings. However, further research is needed to assess the full potential of VR in the classroom, as well as to explore its implications. Such research will be essential in order to ensure that the use of VR in the classroom is effective, ethical and secure [39-41].

X. CONCLUSIONS

There are a number of benefits and implementation issues revealed by the analysis of the use of IoT technology in automating lathe production operations. The advantages include cost savings, improved productivity, and increased accuracy and precision. However, the use of IoT technology in lathe production processes is still in its infancy, and there are a number of obstacles that must be overcome. These include security and privacy concerns, lack of interoperability, and lack of standardization. Additionally, there are several IoT-enabled solutions that have been successfully deployed in lathe manufacturing processes, providing valuable insights into the potential of IoT-enabled automation for the industry [42]. Finally, there are potential applications of IoT technology in lathe manufacturing processes that could bring further benefits, including improving of inventory management, predictive maintenance, and real-time tracking and control. In conclusion, automating the manufacturing processes for lathes using IoT technology has the ability to completely transform the sector. Along with increased productivity, accuracy, and precision, it can result in substantial cost savings. However, there are several challenges that need to be addressed before the technology can be fully implemented [43]. Additionally, there are several IoT-enabled solutions that have already been successfully deployed in lathe manufacturing processes, providing insights into the potential of IoT-enabled automation for the industry. Finally, there are potential applications of IoT technology in lathe manufacturing processes that could bring further benefits, including real-time monitoring and control, predictive maintenance, and improved inventory management [44-46].

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