

**LATHE MACHINE VIBRATION PREDICTION: AN INDUSTRY 4.0
PERSPECTIVE**¹Akshata Sorate, ²Sonal More, ³Ajinkya More**ABSTRACT**

The prediction of vibration between the tool and workpiece is important as a guideline to the machine tools used for an optimal selection of depth of cut and spindle rotation to minimize the vibration. This can be done by different approaches. Industrial vibration analysis is a measurement tool used to identify, predict, and prevent failures in machinery. Implementing vibration analysis on the machines will improve the reliability of the machines and lead to better machine efficiency and reduced downtime eliminating mechanical or electrical failures. Vibration analysis programs are used throughout industry worldwide to identify faults in machinery and keep machinery functioning for as long as possible without failure. The present work concentrates and aims at Using IoT. We can track real-time vibrations and monitor the system to increase productivity. During the machining operation, low surface finish is occurred due to wear and tear of a tool, and also to lose the mounting lead to increase vibrations which will accelerate machine wear, consume excess power, and cause equipment to be taken out of service, resulting in unplanned downtime. Other effects of vibration include safety issues and diminished working conditions After collecting all this information. Out of the above-mentioned factors we chose the vibration factor because it not only affects jobs or products but also harms people in many ways. Hence, we have developed IoT-based machine monitoring solution which can adapt to track the real-time performance of lathe machine. To monitor excessive vibration from the lathe machine to achieve better results in the job with the help of sensors & the HC-05 Bluetooth module, we can catch the real-time values of vibration on our mobile as a notification. In this method, we have established the system which uses a vibration sensor (sound sensor) that detects the excessive noise during machining operation and sends the signal to various devices like mobiles, laptops, or desktops through Arduino.

Keywords: *IoT-monitoring, real-time performance, sound sensor, HC-05 Bluetooth module, tracking machines behavior, Improved machine functioning, Lathe, Vibration analysis, Automation, microcontroller, and IOT, Internet of Things (IoT), Data Analytics,*

INTRODUCTION

Vibration can be caused by a variety of factors. One of the main challenging problems of present-day machine tools is the development of machine tools with high vibration-proof qualities. Often while using a lathe machine there may be vibrations produced in the chuck. This vibration is transmitted to the workpiece resulting tool and the lathe machine itself. To prevent the vibration, this system is used to measure the vibrations continuously and signal the user in case it becomes the safe value. Metal cutting or simply machining is one of the oldest processes for shaping components in the manufacturing industry. The challenge of modern machining industries is focused mainly on the achievement of high quality, in terms of workpiece dimensional accuracy, surface finish, high production rate, less wear on the cutting tools, the economy of machining in terms of cost-saving and increase the performance of the product with reduced environmental impact. Tool wear weakens the cutting tool, increases the forces used in cutting, and causes a lack of consistency in material removal. Machine and machine tools are always subjected to vibration. These vibrations are mainly causing due to In-homogeneities in the workpiece material Variation of chip cross-section Disturbances in the workpiece or tool drives Dynamic loads generated by acceleration/deceleration of massive moving components.

2.CONCEPT GENERATION

2.1 IoT in Real Time Tracking in Machine Performance

IoT technologies such as wireless communications are used for capturing real-time machines' statuses. After that, such information is visualized through a graphical dashboard after being processed by various data models and cloud-based services over smart phones. a real-time monitoring system that utilizes IoT-based sensors, big data processing, and a hybrid prediction model is proposed and real-time processing engine is used to store the sensor data from the manufacturing process. Implementing an IoT-based machine monitoring solution is an innovative method that you can adopt to track the real-time performance of your machines. we get readings from noise sensor with the help of mobile phone, we can say we tracked real time machine performance on IOT based, which provide high accuracy, high productivity. IoT devices, specifically RFID readers and tags are systematically deployed in typical manufacturing sites like shop floors so that various resources could be identified. After that, they are able to sense with each other automatically to get the real-time information

2.2 IoT in Improving Machine Performance

Many condition monitoring techniques are available to monitor the machine health experimentally using sensor, among these techniques' vibration monitoring is highly suited to expand production, improve quality and improving machine performance. The real-time processing characteristics of stream computing to build a data acquisition and analysis platform for lathe machine, this platform monitors the efficiency of the equipment in real time, improve the utilization rate of the equipment, and improve the processing efficiency. IIoT technology enables the collection of data through distributed sensors in real-time and it able to provide a competitive advantage for manufacturers looking to improve their operations. IoT, as a technology, comes with various options and applications that help in increasing machine performance. It especially comes with a sensor-based machine monitoring system through which you can extract and store the data for future analysis. The aims of the paper are to improve on existing definitions of Industrial IoT (IIoT) and to propose a framework for IIoT components as a basis for analysing the use and most important improving machine performance.

2.3 Problem Statement

The lathe Machine performs the multipurpose operation at the same time with the required speed & feed. As we know that the conventional lathe machines are operated by workers. But have you ever wondered that how many difficulties the workers have been facing? & They are still facing it. while working on the lathe machine, also, jobs are getting rejected because of which companies' production rate has been reduced so to understand the root of the problem, we surveyed 2 industries nearby Khalapur, India. After talking with supervisor, we got to know that they manufacture 100 parts/day amongst which 5-10 get rejected. As they mentioned jobs got rejected in quality check. Because of low surface finish which occurs due to wear and tear of a tool, also due to lose mounting. After collecting all this information, a root cause diagram was developed. (Refer fig. 1)

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ROOT CAUSE DIAGRAM REASONS OF JOB FAILURE ON LATHE MACHINE

Fig. 1: Root Cause Diagram

2.4 Motivation

Lathes are exceptionally useful for cutting sheet metal or wood, but if used improperly they can be incredibly dangerous. When using a lathe, it's important to take safety precautions such as wearing proper clothing, maintaining the proper speed, and practicing safe cutting techniques. Besides Vibrations can accelerate machine wear, consume excess power, and cause equipment to be taken out of service, resulting in unplanned downtime. Other effects of vibration include safety issues and diminished working conditions. Out of the above-mentioned factors we chose the vibration factor because it does not only affect the job or product but also harms the people in the following manner: -

- hearing problems
- Loss of grip strength
- loss of sensation (collectively these effects are known as
HAVS (hand-arm vibration-syndrome)
- So, to solve this problem we reached the following approach.

2.5 Objectives

- To monitor excessive vibration from the lathe machine to achieve better results in the job.
- To record the real-time values of vibration on our mobile as a notification.
- To observe the productivity and supervise the control of the machine.

3. METHODOLOGY

A literature review is a study – or more accurately a survey involving scholarly material, to discuss published information about a specific topic and research question. Therefore, to write a literature review you must be a real expert in the object of study. The results and findings will be published and made available to the public namely scientists working in the same area of research. The various research article is referred from the database of google scholar.

3.1 Database Selection

Research databases are organized collections of computerized information or data such as periodical articles, books, graphics, and multimedia that can be searched to retrieve information. Selected all this data from various research papers related to IoT based lathe machine performance, some articles, journals, and google scholar. Also, reviewed several platforms and explored many sensor devices and found a suitable sound sensor and other such devices for this project

3.2 Research Article Keywords Selection

Monitoring system, IoT-based sensor, big data processing, Real-time machine performance, tracking machines behaviour, Improved machine functioning, Lathe, Vibration analysis, Noise sensor, Automation, microcontroller and IoT, Manufacturing, Internet of Things (IoT), Data Analytics, Real-time data.

4. SETUP ARRANGEMENT

ARDUINO UNO is an open-source project, software/hardware is extremely accessible and very flexible to be customized and extended It is flexible, offers a variety of digital and analog inputs, SPI and serial interface and digital and PWM outputs. It is easy to use, connects to the computer via USB and communicates using standard

serial protocol. Schematic diagrams are normally about electrical circuits that show how the different components of a circuit are connected. An electrical schematic diagram will help users to design a circuit system, or monitor the system. In this fig 4.1, It has been shown that this arrangement is made using the HC-05 Bluetooth module which is used to display readings on mobile phones or desktops (as per convenience). This connection is being done using Blynk app which has installed on mobile phones. There is need to make certain changes in the advanced settings of the Blynk app in additionally enter your Bluetooth module serial number to the configuration setting then run the program. The code used to run this application is mentioned below. The sound sensor is used to record vibration (in terms of sound) constantly as there is need to keep the Bluetooth button on of mobile as well as of Bluetooth module. As soon as it disconnects from the system, sensor will stop giving readings on the device.

Fig. 3, shows an arrangement of a sound sensor, Bluetooth module, and Arduino UNO with each other. As the sound sensor input voltage is 5v so VCC of the sensor is connected to pin D7 of Arduino UNO. And the output is connected to A0 of Arduino pins. And the GND of the sound sensor is connected to the GND of Arduino UNO. In the Bluetooth module, there is need to make certain connections like Transmit Data pin of the module to Receive Data pin of Arduino UNO and Receive Data pin of the module connected to Transmit Data pin of Arduino UNO. VCC of module connected to the 5v pin of Arduino. GND of the module is connected to the GND of Arduino UNO.

4.1 Setup Specification

In this research work, component specification details are as follows:

4.1.1 Arduino Uno

- ✓ Microcontroller: microchip ATmega328PT
- ✓ Operating voltage: 5 volts
- ✓ Input voltage: 7-20volts
- ✓ Digital I/O pins :14
- ✓ 12C: 1
- ✓ SPPI :1
- ✓ Analog Input Pins: 6
- ✓ DC Current Per I/O Pin: 20mA
- ✓ DC Current For 3.3V Pin: 50mA
- ✓ Flash Memory: - 32KB

4.1.2 Sound Sensor

- ✓ Operating Voltage: 3.3V to 5V DC
- ✓ LM393 comparator with threshold preset.
- ✓ PCB Size: 3.4cm * 1.6cm
- ✓ Induction distance: 0.5 Meter
- ✓ Operating current: 4~5 mA
- ✓ Microphone Sensitivity (1kHz): 52 to 48 dB

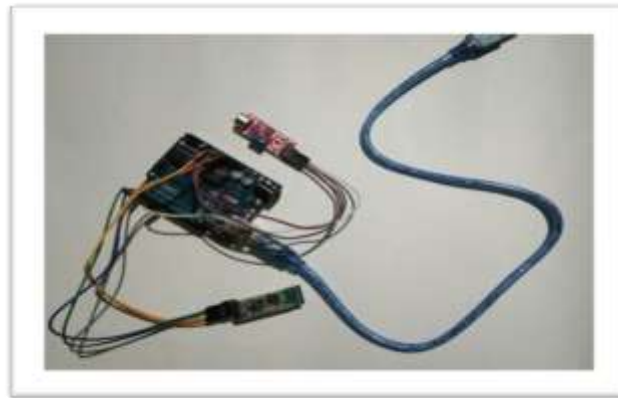


Fig. 4: Actual Setup Wiring Diagram

5.Code Used to Run the Application

```
#define BLYNK_USE_DIRECT_CONNECT

// You could use a spare Hardware Serial on boards that have it (like Mega)

#include <SoftwareSerial.h>

SoftwareSerial DebugSerial(2, 3); // RX, TX

#define BLYNK_PRINT DebugSerial

#include <BlynkSimpleSerialBLE.h>

// You should get Auth Token in the Blynk App.

// Go to the Project Settings (nut icon),

char auth[] = "YnpGokIoOGpsei0CM-MXhUece5FLOUC1";

void setup()

{

    // Debug console

    DebugSerial.begin(9600);

    pinMode(7, OUTPUT);

    digitalWrite(7, HIGH);

    DebugSerial.println("Waiting for connections...");

    // Blynk will work through Serial

    // 9600 is for HC-06. For HC-05 default speed is 38400
```

// Do not read or write this serial manually in your sketch

```
Serial.begin(9600);
```

```
Blynk.begin(Serial, auth);
```

```
}
```

```
void loop()
```

```
{
```

```
Blynk.run()
```

6. READINGS

These are the readings of vibration occurs in lathe machine using a setup of instruments like Arduino, sound sensor, Bluetooth module (HC-05) device, and other required things like cables and wires. & sound sensor had mounted on the chuck of the lathe machine such that it will give maximum vibration or sound values. All recorded sound values are displayed on cellphone via Bluetooth module through Arduino connection.

Table 1: Sound Measurement Readings

No. of Measure	The sound Intensity level at the laboratory (dB)	Time of response	Sound Intensity level on the shop floor (dB)	Time of response
1	474	12:05:02	480	1:15:10
2	479	12:05:08	540	1:15:16
3	478	12:05:15	500	1:15:23
4	471	12:05:22	490	1:15:30
5	475	12:05:28	550	1:15:36
6	481	12:05:35	570	1:15:43



Fig. 5: Sound Measurements in (dB)

CONCLUSION

In this project, this project is mainly focusing on the study of the lathe machine. In this project developed system is measures the vibration consecutively and displays the values of vibration on mobile. After examining the above graphs and charts, its conclusion says that making IoT based framework monitors the performance of lathe machine & affects the social & economical life. In this research paper all information regarding lathe machine and their parts, about internet of things (IoT), its applications, advantages, and disadvantages, etc are discussed. & this study expresses that how excessive vibration can damage a product. Besides what are the techniques can be used to monitor such vibrations. Sensor can monitor the lathe machine overall and can catch the real-time values of vibration on a cellphone as a notification thus Increases the productivity of the machine, and collected necessary data, & readings of vibration amplitude in terms of sound (dB) w.r.t time.

FUTURE SCOPE

- This helps to find out vibrations that occur in the machine system. It will be a good example to study the vibration system in machine components and their working. It will help a student to know and understand the system.
- Many works have been going on to reduce the number of vibrations and to maintain those vibrations. In our project, we are using such a system that will notify the vibrations that occur in the system. So that while performing the machining operations it becomes easy to notify increased vibrations in the lathe machine.
- Nowadays engineers require this kind of technology that helps to manage and optimize all aspects of manufacturing processes and supply chain. It gives access to the real-time data and insights need to make smarter, faster decisions about business, which can ultimately boost the efficiency and profitability of an entire operation.
- IoT allows companies to automate processes and save money on labor. It also reduces waste and improves service delivery, making it less expensive to manufacture and deliver goods and providing transparency into customer transactions. It can create information about the connected objects, analyze it, and make decisions; in other words, one can tell that the Internet of Things is smarter than the Internet. Security cameras, sensors, vehicles, buildings, and software are examples of things that can exchange data with each other. So, it is the demand of time. Such useful things, students will study and understand.

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