To

IITD-AIA Foundation of Smart Manufacturing

Date:18-06-2023

Subject: ***Weekly Progress Report for Week-2.***

Dear Sir,

Following is the required progress report of this week dated from 12-06-2023 to 18-06-2023.

Weekly Progress:

June 12:

Topics covered:

- I have gone through some research papers today as well which are related to the project to know the approach and challenges faced while doing the project.
- *Here are some of my learnings from those papers*:

1. The selection of suitable machining parameters is an important task to obtain a suitable surface finish at the least possible tool wear when machining a lathe machine.
2. In the paper a fuzzy logic control system is developed to predict both surface roughness and tool wear result as a function of the cutting parameters and the different volume percent of nano particulates under experimental consideration.
3. Thus, a fuzzy logic control system can be used to predict both surface roughness and tool wear in turning of such materials under the considered range of conditions.

June 13:

Topics covered:

- I have explored the smart Lathe machine.
- Smart Lathe machine has several components, they include:
- Feed axis sensor
- Depth of cut sensor
- DRO-Digital Read-Out (it displays)
- PLC-Programmable Logic Controller
- Energy Meter- displays real time current rate
- 3 Vibration sensors
- NI cDAQ

June 14:

Topics covered:

- I have explored the different ways or techniques of Tool Wear prediction.

- Using Cutting temperature
- Using workpiece surface texture and *ultrasonic wave*
- The method of using *infrared temperature sensors* to measure the tool surface temperature to predict tool wear has been widely used and studied.
- *Metal cutting* is a very complex process, and the dynamic behavior has strong randomness and nonlinearity. Accurate and reliable feature extraction of a large number of nonstationary signals is an important part of *online monitoring research* on tool wear prediction.

June 15 & June 16:

Topics covered:

- I have explored the different ways or techniques of Surface Roughness prediction.
- Surface roughness refers to deviation from the nominal surface of the third up to sixth order. Order of deviation is defined in international standards.
- Machining theory based approach: The theory of machining such as process kinematics, cutting tool properties, chip formation mechanism etc. Computer-aided design (CAD) methods and tools are utilized in order to predict the surface roughness.
- Designed experiments approach: Systematic method concerning the planning of experiments, collection and analysis of data with near-optimum use of available resources.
- The response surface methodology (RSM) and Taguchi techniques for design of experiments (DoE) seem to be the most wide-spread methodologies for the surface roughness prediction.
- Artificial Intelligence Approach

June 17:

Topics covered:

- Predictive Maintenance involves performance monitoring and equipment condition monitoring during regular operations to reduce the chances of a breakdown.
- The primary objective of predictive maintenance is to find patterns that can help predict and ultimately reduce the failures of machines. Vibration analysis, oil analysis, thermal imaging, equipment observations, etc., are a few common examples of predictive maintenance.
- We use Machine learning for predictive maintenance because ML eliminates most of the guesswork and helps facility managers focus on other tasks.
- ML enables you to-

1. Create predictive models for maximizing asset lifetime, operational efficiency, or uptime.
2. Leverage past and continuous data.
3. Optimize the periodic maintenance operations.

- Predictive Maintenance Using Machine Learning allows you to run automated data processing on an example dataset or your own dataset.

- The included ML model detects potential equipment failures and provides recommended actions to take.
- There are mainly two machine learning-based predictive maintenance approaches as follows:

1. Classification approach.
2. Regression approach.

June 18:

Topics covered:

- Use of Classification and Regression in machine learning for predictive maintenance.
- Classification in machine learning is an essential technique used for predictive maintenance approaches.
- In the context of predictive maintenance, classification models are trained using historical data that includes information about the operating conditions, sensor readings, and failure events of the equipment or system.
- Regression in machine learning is commonly used in predictive maintenance approaches to forecast and predict the future behavior of machines or equipment.
- The goal is to learn patterns and relationships between these features and the occurrence of failures or maintenance needs.
- By leveraging classification models, predictive maintenance approaches can proactively identify and address potential issues, reduce unplanned downtime, optimize maintenance costs, and improve overall operational efficiency.