To

IITD-AIA Foundation of Smart Manufacturing

Date:11-06-2023

Subject: ***Weekly Progress Report for Week-1.***

Dear Sir,

Following is the required progress report of this week dated from 8-06-2023 to 11-06-2023.

Weekly Progress:

June 08:
Topics covered:

- Learned about the *Hardware* that is being leveraged in the project which is the Lathe Machine**.**
- I understood the relation between *tool wear* and the *surface roughness* of the Lathe machine. Both depend on various different factors such as cutting speed.
- *Factors Affecting Tool Wear and Surface Roughness*:
    1. Cutting Parameters- Surface roughness and tool wear are affected by parameters such as cutting speed, feed rate, and depth of cut.
    2. Tool Material- Different tool materials wear at different rates and may result in different surface roughness.
    3. Workpiece Material- Different workpiece materials can cause different levels of wear in the tool and resulting surface roughness, etc.
- *Importance of Predicting Tool Wear and Surface Roughness*:
    1. Minimizing Costs- By predicting tool wear early, you can avoid costly machine repairs and replacements.
    2. Optimizing Product Quality- Surface roughness can affect product quality. Predicting it can help you make adjustments to improve it.
    3. Increasing Efficiency- Predicting tool wear and surface roughness can help you optimize your cutting parameters and increase your productivity.

June 09:
Topics covered:

- I have explored the areas of *tool wear* and the *surface roughness* of the Lathe machine.

- Importance of Predicting Tool Wear and Surface Roughness, and different Methods for Predicting Tool Wear and Surface Roughness.
- *Methods for predicting Tool Wear and Surface Roughness which includes*:
    1. Tool Wear Measurement- Using contact measurement tools like microscopy, stylus profilometry and laser scanning to measure tool wear.
    2. Surface Roughness Measurement- Using optical techniques, contact probes, and noncontact techniques to measure surface roughness.
    3. Data Analysis- Using neural networks, fuzzy logic, regression analysis, and decision trees to analyze data and predict tool wear and surface roughness.

June 10:

Topics covered:

- Predicting tool wear and surface roughness in machining processes is a complex task that involves numerous factors and variables.
- While there have been advancements in the development of predictive models and techniques, several limitations and challenges still exist.
- *Some of the key limitations and challenges include*:
    1. Process Variability- Machining processes can exhibit significant variability due to factors such as material properties, cutting parameters, tool condition, and machine tool characteristics. Predictive models need to account for this variability, which can be challenging to capture accurately.
    2. Nonlinear Relationships: The relationships between input parameters (e.g., cutting speed, feed rate) and tool wear or surface roughness are often nonlinear.
    3. Lack of Sufficient Data: Predictive models require large amounts of high-quality data for training and validation.
    4. Dynamic Nature of Tool Wear: Tool wear is a dynamic process that evolves over time, etc.

June 11:

Topics covered:

- I have gone through some research papers related to the project to know the approach and challenges faced while doing the project.
- *Here are some of my learnings from those papers*:
    - ➔ The general manufacturing problem can be described as the achievement of a predefined product quality with given equipment, cost and time constraints.

- ➔ One of the papers aims at presenting the various methodologies and practices that are being employed for the prediction of surface roughness.
- ➔ The resulting benefits allow for the manufacturing process to become more productive and competitive and at the same time to reduce any re-processing of the machined workpiece so as to satisfy the technical specifications.
- ➔ Each approach with its advantages and disadvantages is outlined and the present and future trends were discussed.
- ➔ The approaches are classified into those based on machining theory, experimental investigation, designed experiments and artificial intelligence (AI).

Figure 1. CNC lathe machine.

Figure 2: Arrangement of sensor on the boring bar

References:

1. *Predicting Surface Roughness In Machining: A Review – P.G. Benardos & G.-C. Vosniakos*
2. *Prediction of Surface Roughness Based on Machining Condition and Tool Condition in Boring Stainless Steel-304.*

Tasks_ID	Name	Start Date	End Date	Duration(in Days)
1	Project kickoff and planning	01-06-2023	01-06-2023	1
2	Literature review on tool wear and surface roughness	02-06-2023	03-06-2023	2
3	Define project objectives and research questions	04-06-2023	06-06-2023	3
4	Gather necessary data and specifications	07-06-2023	08-06-2023	2
5	Design and develop data collection setup	09-06-2023	11-06-2023	3
6	Collect initial data for analysis	12-06-2023	07-06-2023	3
7	Preprocess and clean collected data	15-06-2023	16-06-2023	2
8	Explore and analyze the data	17-06-2023	19-06-2023	3
9	Identify relevant features and variables	20-06-2023	21-06-2023	2
10	Develop initial predictive models	22-06-2023	25-06-2023	4
11	Evaluate and optimize model performance	26-06-2023	28-06-2023	3
12	Validate models using additional data	29-06-2023	30-06-2023	2
13	Fine-tune models and incorporate feedback	01-07-2023	04-07-2023	4
14	Develop visualization tools for results	05-07-2023	06-07-2023	2
15	Prepare project report and documentation	07-07-2023	09-07-2023	3
16	Conduct final model evaluation and testing	10-07-2023	12-07-2023	3
17	Make necessary adjustments and refinements	13-07-2023	14-07-2023	2
18	Prepare final presentation and materials	15-07-2023	16-07-2023	2
19	Project review, feedback, and conclusion	17-07-2023	20-07-2023	4

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