To

IITD-AIA Foundation of Smart Manufacturing

Date:25-06-2023

Subject: ***Weekly Progress Report for Week-3.***

Dear Sir,

Following is the required progress report of this week dated from 19-06-2023 to 25-06-2023.

Weekly Progress:

June 19:

Topics covered:

- I have learned about Tool wear detection with Decision Tree.
- Using a Decision Tree for tool wear detection:

    a. Dataset Preparation: Gather a dataset that includes labeled examples of tool wear. Each example should consist of input features and a corresponding label indicating whether the tool is worn or not.
    b. Feature Selection: Analyze the dataset and select the most relevant features that are likely to contribute to tool wear detection.
    c. Dataset Split: Divide the dataset into two subsets: a training set and a test set. The training set will be used to build the Decision Tree model, while the test set will be used to evaluate its performance.
    d. Decision Tree Construction: Use the training set to train a Decision Tree classifier. The Decision Tree algorithm will learn from the labeled examples and construct a tree-like model with decision nodes and leaf nodes. The decision nodes split the data based on the selected features, while the leaf nodes represent the predicted class (worn or not worn).
    e. Model Training
    f. Model Evaluation
    g. Predicting Tool Wear
    h. Fine-tuning and Optimization

June 20:

Topics covered:

- I have learned about Tool Wear Detection Using Computer Vision System in Machining.
- The computer vision system is used to gather and study the data from an image or a video.

- It studies various properties of the image such as image brightness, color, pixels, contrast, and resolution and gathers data from the image.
- It is necessary to monitor the condition of tool as it affects the quality of the machined part and also the tooling cost.
- Tool wear detection is the process of analyzing the amount of wear on the tool.
- The program calculates the number of pixels within the worn-out part of the tool. The extraction of the worn-out parts from the un-worn part is done by using computer vision operations such as canny edge operation, dilation operation, and erosion operation.
- The program provides an output in the form of an image that shows a worn-out region covered by a blue boundary.
- The program also outputs a value that gives a comparative idea about the tool wear. The higher the magnitude of this ratio, the higher is the amount of tool wear.

June 21 & June 22:

Topics covered:

- I have learned about Surface Roughness Detection.
- Using:
- Multivariable Regression Analysis
- Artificial Neural Network Model
- Regression Models**:**

  Based on the regression coefficients, the mathematical model is given by-
  Ra= 0.2235+ 9.33×10-5 × n+0.2963 × ap − 3.6×10-5× n× ap -2.6 ×10-4× ap ×f -3.48×10-8 × n × p+4.74×10-8 × ap × n ×f

June 23:

Topics covered:

- I have done Data Exploration i.e, I have explored the dataset which was provided.
- The dataset has experimental outputs based on which the predictions about the tool wear and surface roughness can be made.
- The Dataset contains RPM which means revolutions per minute, The lathes are designed to operate at various spindle speeds for machining of different materials. There speeds are measured in RPM (revolutions per minute) and are changed by the cone pulleys or gear levels.
- It has the Feed values of the Lathe machine, The feed of a lathe is *the distance the cutting tool advances along the length of the work for every revolution of the spindle.*
- The dataset has depth values which are the parameter that focuses on the tertiary cutting motion of the tool as the tool is pushed deeper into the workpiece to the specified depth. The parameter impacts the performance and efficiency of the precision machining process.

June 24 & June 25:

Topics covered:

- I have done (EDA) Exploratory Data Analysis on the provided dataset.
- I have imported Libraries that are necessary for data manipulation and visualization, such as Pandas, NumPy, and Matplotlib or Seaborn.
- NumPy can be used to perform a wide variety of mathematical operations on arrays.
- Pandas is a Python library used for working with data sets. It has functions for analyzing, cleaning, exploring, and manipulating data.
- Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python. Matplotlib makes easy things easy and hard things possible.
- Python Seaborn library is a widely popular data visualization library that is commonly used for data science and machine learning tasks.
- Correlation Analysis: Analyzing the relationships between variables using correlation analysis to understand the strength and direction of associations between numerical variables.
- *There are two main types of data:*

1. categorical data (qualitative) and
2. numerical data (quantitative).

- Categorical data: non-numerical information such as gender, race, religion, marital status etc.
- Numerical data: measurement or count such as height, weight, age, salary, number of children, etc.
- I have calculated basic statistical measures for each variable, such as mean, median, standard deviation, minimum, and maximum. To get an overview of the data and identify any outliers or unusual values that may be useful in further investigation.
- I have found the mean of the columns- RPM, feed rate, depth of cut, and surface roughness (Ra).
- Have applied mode on the surface roughness Ra of the dataset as the median is useful when dealing with numerical variables that may have outliers or skewed distributions.