

## Theme 2: Electronics Engineering / Biomedical Engineering

**AI areas:** Machine Learning, Activity Recognition, Feature Engineering, Predictive analytics

**Format of Data:** Raw motion data from sensors

**Topic:** Detecting Worker's activity and knife sharpness using body-worn sensors to understand Worker's productivity and safety in a manufacturing plant.

**Description:** Using motion data obtained from body-worn sensors in different body positions, detect the Worker's activity, such as cutting, slicing, and knife sharpness. The project group will get existing data but must label it by themselves.

### Key Question to Answer

1. What activity is detected by your model (e.g., cutting, slicing, idle)
2. What is the quality of the knife (blunt, medium, sharp) and predict when to sharpen the knife

**Input and Output of final AI model** Input: raw sensor data of 1 minute

Output:

1. Identified Worker's activity
2. Identified knife sharpness and recommendation for the next stage of the sharpness

### Data Source

The data provided for this Theme is in the [Design Project](#) under the Theme2 folder. There are two folders, "P1" and "P2", which refer to Person1 and Person2. For each person, there are two cutting-type activity data: boning and slicing. Under "boning" and "slicing", you will find a data file with the name format: MVN-J-abc-xyz-pqr where abc refers to one of the cutting types (boning or slicing), xyz is the knife sharpness factor (the more this factor is close to 100 means the current knife is sharper), pqr is the data collected in a different shift for different knife sharpness. Each data file is in .xlsx format, which has 18 tabs. The first tab, "General Information", contains metadata about the file. The "Markers" tab contains labelling, the type of activity the Worker was doing during the marked frame in the list. The activities are labelled as categorical values (0,1,2,3,4,5,...). The remaining tabs contain sensor fusion data of 16 different fusions for 17 body-worn sensors in 23 body positions. For this project, you can only focus on "Segment velocity" and "segment.

Acceleration" tab data. Each tab contains the frame value, the activity class label of that frame and the x,y, and z position data of 23 body positions. So, this data is already labelled. One frame corresponds to 1 second of data.

You must convert knife sharpness into three categories:

- 85 and above: Sharp
- 70 to 84: Medium
- Below 70: Blunt

To solve the problem, you will need to pre-process and extract features of 23 body position data in per-minute intervals in such a way that your model can say which activity the Worker is doing and using what type of knife if new raw data of 60 frames are provided

For example, This data is boning, and the Worker cut (activity 4) with a medium knife.

So, you need to develop 3 Machine learning models and combine their outcomes to provide the answer. You must do the necessary sampling on data to balance the classes.

**Marking criteria distribution**

<b>Task</b>	<b>% weights in marking</b>
Data pre-processing and feature extraction	40
Training and validation using different ML models	20
Classifications on unseen data	15
Evaluation metrics and model comparisons	15
User Interface	10