2.1. Data Collection

Three distinct statuses for experimentation were systematically generated in this phase of the research, encompassing: 1) a healthy ventilation fan, 2) an unbalanced fan of type 1, and 3) an unbalanced fan of type 2. To induce these statuses, a nominal 5 grams mass was introduced onto the fan blade, as illustrated in Figures 1 and 2. A microphone was subsequently positioned at a stable distance of 10 centimeters from the ventilation fan, and recording was initiated for each status. Each status was recorded for approximately 11 minutes, accumulating to a total recording time of 33 minutes. Following this recording phase, the audio file was systematically segmented into 2000 discrete segments, each lasting approximately 1 second. The segmentation process served as the foundation for the compilation of the raw datasets, and images of the experiment are presented.

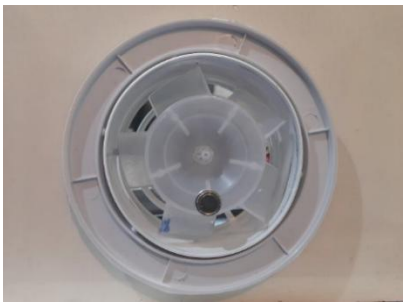

Figure 1 an unbalanced fan type1

Figure 2 an unbalanced fan type2

Figure 3 Healthy fan

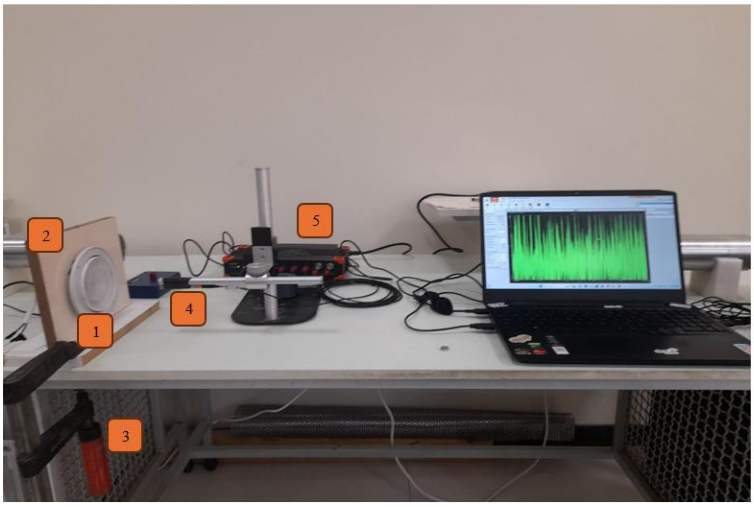

Figure 4. 1: ventilation fan, 2: fan station, 3: fixture, 4: laboratory microphone, 5:data logger

2.2. Feature Extraction

The feature extraction process employed for analyzing audio data collected from ventilation fans in three distinct operational states is defined in this section. The chosen features for this investigation were Spectral Rolloff, Spectral Contrast, Spectral Bandwidth, Spectral Centroid, Bandwidth Ratio, Zero-Crossing Rate, Root Mean Square (RMS), Mean Wavelength, and Maximum Frequency. Valuable insights into the characteristics of the audio signals were offered by each feature, facilitating the differentiation between different states of the ventilation fans.