I. INTRODUCTION

Temperature is a measure of the average kinetic energy of the particles in a substance or system. In simpler terms, it tells us how hot or cold something is [1]. When the temperature of a substance increases, its particles move faster on average, while a decrease in temperature results in slower particle movement [2]. Temperature is typically measured in degrees Celsius (°C), Kelvin (K), or Fahrenheit (°F). It's a fundamental concept in physics, chemistry, engineering, meteorology, and many other fields, influencing various aspects of our daily lives [3].

Temperature monitoring is crucial because temperature affects various processes and systems in daily life, as well as in many industries and technical applications [4]. Temperature influences human health and safety, the efficiency and quality of production processes, the security of electronic devices, plant growth and ecosystem balance, as well as transportation and storage product safety. By monitoring temperature, we can prevent dangers related to extreme temperature, maintain product quality, manage agriculture more effectively, secure electronic devices, and ensure environmental sustainability and product safety during transportation and storage [5].

In the oil and gas industry, monitoring temperature fluctuation is crucial for ensuring operational efficiency, safety, and the longevity of equipment [6]. Temperature anomalies, if left undetected, can lead to equipment malfunction, production disruption, and safety hazard [7].

Data anomaly in temperature refers to values that are unusual or unexpected within the observed temperature dataset [8]. This could include temperature significantly higher or lower than surrounding values within a specific time frame or location [9].

Detecting temperature anomalies is important because they can indicate significant weather changes, natural events such as storms or wildfires, or even errors in data measurement or recording [10]. Information about temperature anomalies can be helpful in climate monitoring, weather forecasting, natural disaster risk management, and climate change policy [11].

Machine learning techniques offer a promising avenue for temperature classification, with Convolutional Neural Network (CNN) emerging as a particularly effective method. CNN excels at capturing spatial patterns in multidimensional data, making them well-suited for anomaly detection tasks [12].

The use of deep learning techniques, especially Convolutional Neural Network (CNN) and transfer learning, for anomaly detection in time series data has been successfully used with satisfactory results, and further research could involve comparing performance with benchmark algorithms as well as exploring factors that influence transfer learning performance [13].

CNNs excel at extracting complex and deep spatial features from multidimensional data. This capability enables CNNs to detect unusual patterns or anomalies that might not be evident with traditional anomaly detection methods [14]. Pooling layers help reduce the dimensionality of data while preserving important features, enhancing the efficiency of anomaly detection by reducing noise and emphasizing anomalous signals [15]. Common data augmentation techniques used with CNNs help the model learn to detect anomalies under diverse conditions. This includes rotating, scaling, and translating images, making the model more robust to variations in data [16].

Developing an air temperature prediction model in Padang City, West Sumatera, using Convolutional Neural Network (CNN), Multilayer Perceptron (MLP), and a hybrid of the two models based on monthly air temperature data from January 2015 to December 2017. The research results show that the CNN model provides the most satisfactory results with an R2 value of 0.9965 which shows that the CNN model is best used in predicting air temperature [17].

Soil temperature predictions get accurate results using the Convolutional Neural Network (CNN) model. The data used is hourly climate data to train and test the CNN model, with data normalization to reduce the model's sensitivity to the scale of climate features. The research results show that the one-dimensional CNN model is better at predicting soil temperature than the multilayer perceptron model, especially in normal and hot weather conditions, and is able to predict daily maximum soil temperature [18].

Convolutional Neural Network (CNN) is used to detect mask use and body temperature. The system will close the portal automatically if someone is not wearing a mask or has a body temperature above 37.5°C. Test results show mask detection accuracy of 94% with a computing time of 9.09 seconds. The system also achieved 100% accuracy in integrating mask detection and infrared temperature sensors, marking an important step in preventing the spread of COVID-19 [19].

In diabetics, foot ulcers are a serious complication, however, they can be detected early through thermogram images that measure temperature differences in the foot area. Using four pre-trained CNN models accelerates the process of adapting this technology in clinical settings, providing a solid foundation for further implementation in medical practice [20].