Report on AI/ML Model Development for Fire Safety System

Objective: Develop a prototype AI/ML model aimed at enhancing fire safety measures.

Sensor Data Interpretation:

Approach: The approach involved loading, preprocessing, exploring, and modeling sensor data related to smoke and temperature. This process aimed to extract insights and develop predictive models for enhancing fire safety measures.

1. Loading and Preprocessing:
- Loaded smoke and temperature data using Pandas.
- Preprocessed data by converting timestamps to datetime, checking for null and duplicate values, and merging datasets.

2. Exploratory Data Analysis (EDA):
- Explored data through correlation analysis and visualization to identify relationships between variables such as smoke level, temperature, and time.
- Engineered features from the timestamp column to extract hour, day, month, and year components.

3. Model Building and Evaluation:
- Defined features and target variables.
- Split the dataset into training and testing sets.
- Built machine learning models including Logistic Regression, Random Forest, Support Vector Machine, and XGBoost.
- Evaluated model performance using accuracy, precision, recall, and F1 score.

Results:
- Identified correlations between variables and developed predictive models with satisfactory performance predicting smoke detection.
- Extracted useful features from the timestamp column to improve model accuracy and interpretability.

Challenges Faced:
- The dataset is so small that it was very difficult to analyze and extract insights from it.
- Selecting the appropriate machine learning algorithms and evaluation metrics required experimentation and comparison.

Visual Detection Model:

Approach: The approach involved loading, preprocessing, and modeling image data for visual detection of smoke. This process aimed to develop a convolutional neural network (CNN) model capable of accurately identifying smoke in images.

1. Loading and Preprocessing Images:
- Loaded smoke and non-smoke images from respective folders and preprocessed them.
- Assigned labels (1 for smoke, 0 for non-smoke) to the images.

2. Exploratory Data Analysis (EDA):
- Split the dataset into training and testing sets.
- Visualized the class distribution of images using bar and pie charts.

3. Model Building and Training:
- Constructed a sequential CNN model using TensorFlow's Keras API.
- Compiled and trained the model on the training data for multiple epochs.

4. Model Evaluation:
- Evaluated model performance on the test data using accuracy, F1 score, and Intersection over Union (IoU).

5. Prediction on New Images:
- Used the trained model to predict smoke in new images.
- Preprocessed the new images and passed them through the model for prediction.
- Visualized predictions alongside respective images.

Results:
- Developed a CNN model capable of accurately identifying smoke in images with reasonable performance metrics.
- Successfully made predictions on new images and visualized the outcomes.

Challenges Faced:
- Very few images for both classes.
- Preprocessing images for the visual detection model involved managing image quality and size variations.
- Selecting appropriate evaluation metrics for assessing model performance accurately required careful consideration of specific goals and requirements.