portance scores.

The culmination of these efforts yielded a refined dataset ready for the Hybrid IDS. This meticulous preprocessing ensures that subsequent supervised and unsupervised models can seamlessly harness the dataset's essence, culminating in an adept defense against dynamic cyber threats.

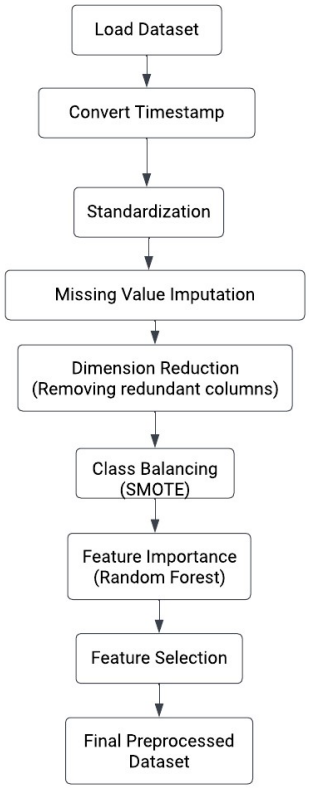

Figure 3.1: Data Pre-processing

3.2.1 Data Standardization

Data standardization, a pivotal data preprocessing step, aimed to harmonize the scale of numerical attributes. By centering attribute means around zero and scaling standard deviations to one, this technique mitigated the influence of differing magnitudes. The resulting uniform scale facilitated fair comparisons and prevented attributes with larger values from overshadowing the learning process. This standardization contributed to both supervised and unsupervised models within the Hybrid Intrusion Detection System (IDS), enhancing convergence and accuracy. By ensuring attributes were interpreted based on significance rather than scale, the IDS effectively tackled known attack

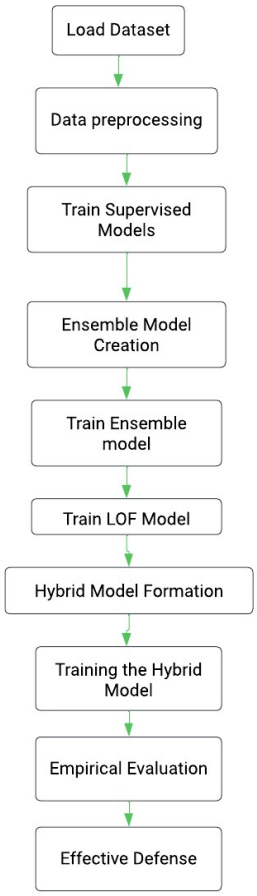

Figure 3.4: Project Flow Chart

3.5.1 Dataset Selection and Preprocessing

Our journey commences with the selection of a cutting-edge IDS attacks dataset meticulously tailored to meet the demands of our project's objectives and computational capacity. The dataset, a digital treasure trove of attack information, is the foundation for our HIDS. Following this, a pivotal data preprocessing phase ensues, encompassing critical steps like data standardization, null value handling, and dimensionality reduction. The orchestration of these steps ensures that our data is primed for advanced modeling.

3.5.2 Exploring Supervised Models

With a prepared dataset, our exploration takes a new turn. We venture into supervised models, journeying through the decision trees, logistic regression, and the powerful trio of XGBoost, LightGBM, and CatBoost. This expedition is fueled by the intent to discern the models best equipped to decipher known attack patterns. Each model's distinct

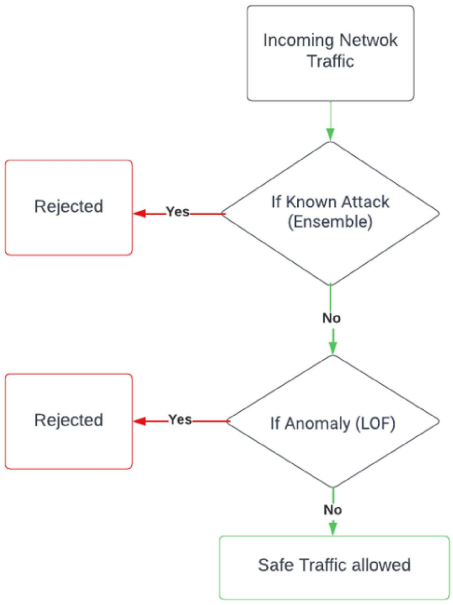

Figure 3.5: Hybrid model working flow

The journey through the project, from dataset curation to Hybrid IDS formation, reveals a remarkable transformation. The Hybrid Intrusion Detection System goes beyond algorithms, becoming a cohesive defense that embodies innovation and vigilance. This journey showcases dedication to securing the digital realm and creating a safer digital future.