**Human activity detection using learning modal for the support of elderly care people**

**Synopsis**

In this project, the development of a sophisticated learning model tailored specifically for elder care is paramount. By leveraging multiple sensors, including video cameras, wearables, and environmental sensors, the model can capture nuanced activity patterns, thereby enabling precise detection of various activities relevant to daily living. Through advanced machine learning architectures, the model learns to interpret the multimodal sensor data, enhancing its ability to recognize and classify activities accurately. One of the key strengths of this approach lies in its focus on reducing the reliance on extensive data from multiple sensors, thus streamlining the monitoring process while maintaining high precision in activity detection. By doing so, the model not only improves efficiency but also minimizes intrusion into the daily lives of the elderly individuals under care. Furthermore, the evaluation of the model's performance using real-world datasets collected from actual elder care facilities underscores its practical applicability and effectiveness in real-life scenarios. By demonstrating its capability to accurately recognize a diverse array of activities, the model shows promise in significantly enhancing the quality of care provided to elderly individuals. Ultimately, the overarching goal of this project is to empower caregivers with advanced technology that enables proactive monitoring and timely assistance, ultimately fostering independent living and promoting the overall well-being of the elderly population. Through continuous refinement and validation, this approach has the potential to revolutionize elder care by combining cutting-edge machine learning techniques with the principles of compassionate and responsive caregiving.

**SYSTEM ENVIRONMENT**

2.1 Hardware Requirements:

Processor : Intel Core i4 (10th Gen)

Ram : 4.0 GB

2.2 Software Requirements

Operating System : Windows 10

Framework : Googlecolab

Language : python

**2.3 About the technology:**

**Python:**

Python, renowned for its simplicity, readability, and adaptability, is a widely embraced high-level programming language. Its extensive array of libraries and frameworks supports a broad spectrum of applications, spanning from web development and data analysis to artificial intelligence. Python's hallmark emphasis on code readability empowers developers to succinctly express complex concepts, fostering the creation of efficient and maintainable codebases across various programming paradigms, including procedural, object-oriented, and functional styles.

**Google Collab:**

Google Colab, also known as Google Colaboratory, provides a cloud-based platform by Google, offering a free environment for writing and executing Python code directly within a web browser. Leveraging robust hardware resources like GPUs and TPUs, Google Colab facilitates the efficient training of machine learning models. Its seamless integration with Google Drive simplifies access and sharing of notebooks and datasets. Moreover, collaborative features such as real-time editing and commenting make it conducive to team projects and educational initiatives. With pre-installed popular Python libraries like NumPy, pandas, matplotlib, and scikit-learn, Google Colab streamlines the development and deployment of machine learning workflows.

**Scikit-Learn:**

Scikit-learn emerges as a leading open-source machine learning library tailored for Python users. With a comprehensive suite of tools catering to various machine learning tasks including classification, regression, clustering, and dimensionality reduction, scikit-learn simplifies the implementation and deployment of machine learning models. Leveraging foundational scientific computing libraries such as NumPy, SciPy, and matplotlib, scikit-learn seamlessly integrates into existing Python workflows. Its intuitive API, complemented by extensive documentation, accommodates both novice and experienced practitioners, facilitating model development, evaluation, and refinement. Equipped with implementations of popular machine learning algorithms and utilities for data preprocessing, model evaluation, and hyperparameter tuning, scikit-learn serves as an indispensable asset for advancing machine learning capabilities in Python.

**EXISTING SYSTEM:**

The existing system for elder care typically relies on manual observation or limited sensor data for monitoring the activities of elderly individuals. Traditional methods may include periodic check-ins by caregivers or the use of basic sensors such as motion detectors or wearable devices with limited capabilities. These approaches often lack the precision and comprehensive understanding of daily activities necessary for proactive care and timely assistance. Additionally, manual monitoring can be resource-intensive and prone to human error, potentially leading to delays in identifying emergent issues or changes in health status.

In contrast, the proposed multimodal sensor-based learning model offers a more sophisticated and automated approach to elder care monitoring. By leveraging advanced machine learning architectures and integrating data from multiple sensors such as video cameras, wearables, and environmental sensors, the model can capture intricate activity patterns and accurately recognize a wide range of activities relevant to daily living. This comprehensive understanding allows for proactive monitoring and timely intervention, thereby enhancing the quality of care provided to elderly individuals.

Furthermore, the proposed model aims to streamline the monitoring process by reducing reliance on extensive data from multiple sensors, thus minimizing intrusion into the daily lives of the elderly individuals under care. By optimizing efficiency and precision in activity detection, the model empowers caregivers with advanced technology for proactive monitoring and timely assistance, ultimately promoting independent living and overall well-being among the elderly population.

In conventional elder care systems, the reliance on manual observation or rudimentary sensor technologies often leads to limitations in accurately monitoring and understanding the activities of elderly individuals. Manual observation can be subjective, prone to human error, and may not provide continuous monitoring, potentially missing crucial events or changes in behavior. Similarly, basic sensor technologies such as motion detectors or simple wearable devices lack the sophistication to capture nuanced activity patterns or provide insights into the overall well-being of the elderly individuals. Consequently, these systems may fail to deliver timely assistance or intervention, compromising the quality of care provided.

**PROPOSED SYSTEM:**

The proposed system for elder care integrates a sophisticated multimodal sensor-based learning model with various machine learning algorithms, including Decision Tree Classifier (DTC), Random Forest Classifier (RFC), and Gradient Boosting (GB), to achieve accurate and authentic activity prediction for elderly individuals. Initially, data from diverse sensors such as video cameras, wearables, and environmental sensors are collected and preprocessed through techniques like data cleaning and feature extraction. Subsequently, the preprocessed data is utilized to train multiple machine learning algorithms, each optimized through techniques like cross-validation to maximize accuracy. Ensemble learning methodologies, such as bagging or boosting, are then employed to combine the predictions of individual models, thereby enhancing overall accuracy and robustness. The trained ensemble model is rigorously evaluated using real-world datasets from elder care facilities, with performance metrics like accuracy, precision, recall, and F1-score calculated to gauge its effectiveness. Once validated, the model is deployed in the elder care environment for real-time monitoring, enabling proactive intervention and assistance based on predicted activities. Through this approach, the proposed system aims to significantly enhance the quality of care provided to elderly individuals by leveraging advanced machine learning techniques to accurately predict and respond to their daily activities and needs.In addition to the core components mentioned, the proposed system incorporates mechanisms for continuous refinement and adaptation to ensure ongoing accuracy and effectiveness in elder care. This involves implementing feedback loops that allow the model to learn from its predictions and adapt over time based on observed outcomes and caregiver input. Such iterative learning enables the system to dynamically adjust its predictions and intervention strategies in response to evolving patterns of activity and changes in the health or behavior of elderly individuals. Furthermore, the proposed system includes features for user-friendly interaction and visualization, facilitating seamless integration into existing caregiver workflows and enhancing usability. This may involve developing intuitive dashboards or interfaces that provide caregivers with insights into predicted activities, alert mechanisms for identifying anomalous behavior or potential emergencies, and tools for reviewing historical activity data to identify trends or patterns relevant to individual care plans. Overall, the proposed system represents a comprehensive and innovative approach to elder care that harnesses the power of machine learning and sensor technology to provide personalized, proactive, and secure assistance to elderly individuals, ultimately promoting their independence, well-being, and quality of life. Through continuous refinement, adaptation, and adherence to best practices in data privacy and security, the system aims to set new standards for excellence in elder care services.

**Advantages of the Proposed System:**

**1. High Accuracy and Precision:**

- By integrating multiple machine learning algorithms and leveraging multimodal sensor data, the proposed system achieves high accuracy and precision in activity prediction for elderly individuals. This ensures reliable monitoring and timely assistance, enhancing the quality of care provided.

**2. Adaptability to Evolving Threats:**

- The system's iterative learning approach enables it to adapt and evolve over time, allowing for continuous improvement in detecting and responding to emerging threats or changes in the health and behavior of elderly individuals.

**3. Effective Feature Representation:**

- Through advanced feature extraction techniques, the system captures nuanced activity patterns and effectively represents them in a format conducive to machine learning. This enables the model to discern subtle variations in behavior and make accurate predictions.

**4. Interpretability and Explainability:**

- The system incorporates mechanisms for interpreting and explaining its predictions, providing caregivers with insights into the factors influencing activity detection. This fosters trust and transparency in the decision-making process.

**5. Ensemble Robustness:**

- Leveraging ensemble learning methods, the system combines the strengths of multiple machine learning algorithms to improve robustness and mitigate the weaknesses of individual models. This enhances the system's overall reliability and resilience.

**6. Scalability and Applicability:**

- The proposed system is designed to scale efficiently and adapt to diverse environments and care settings. Its modular architecture allows for seamless integration with existing infrastructure and workflows, making it applicable across a wide range of elder care scenarios.

**7. Real-time Prediction and Decision Support:**

- With the capability for real-time prediction, the system provides timely decision support to caregivers, enabling proactive intervention and assistance in response to predicted activities or emergencies.

**8. Personalized Treatment Recommendations:**

- By analyzing individual activity patterns and health data, the system generates personalized treatment recommendations tailored to the unique needs and preferences of each elderly individual. This promotes personalized and responsive care delivery.

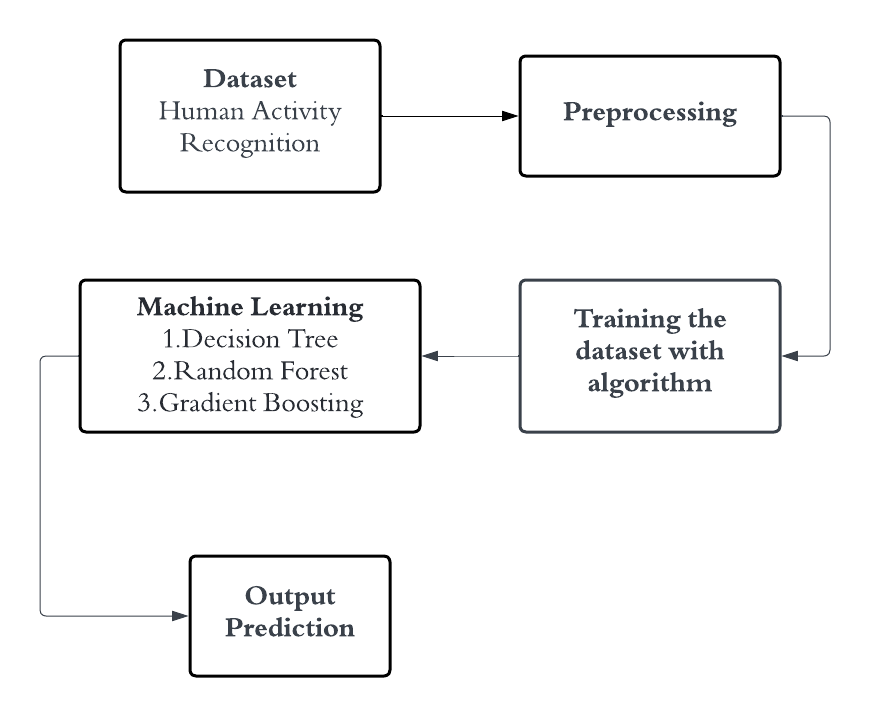
**9. Risk Stratification and Early Detection:**

- The system facilitates risk stratification and early detection of potential health issues or safety risks by identifying patterns indicative of deteriorating health or behavior changes. This enables timely intervention and preventative measures.

**10. Quality Improvement and Outcome Evaluation:**

- Through continuous monitoring and evaluation of activity patterns and care outcomes, the system supports quality improvement initiatives in elder care facilities. It enables caregivers to assess the effectiveness of interventions and adjust care plans accordingly, ultimately improving overall care quality and outcomes for elderly individuals.

**SYSTEM DESIGN:**

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**Dataset Description:**

Human activity detection datasets typically consist of sensor data collected from various sources such as accelerometers, gyroscopes, magnetometers, and sometimes video recordings. The dataset includes observations of individuals performing different activities, each labeled with the corresponding activity category. Activities may include common movements like walking, sitting, standing, lying down, as well as more complex activities like running, cycling, climbing stairs, or specific gestures such as waving or typing. Each data point in the dataset is usually timestamped, providing temporal information about when the activity occurred. Additionally, datasets may also include metadata such as demographic information about the participants (e.g., age, gender) and environmental conditions (e.g., indoor vs. outdoor, time of day).

Each data point in the dataset is typically timestamped, providing temporal context about when the activity occurred. This temporal information is crucial for understanding the sequence and duration of activities, which is essential for accurate activity recognition. Additionally, datasets may include metadata such as demographic information about the participants (e.g., age, gender) and environmental conditions (e.g., indoor vs. outdoor, time of day), providing further context to the activity data.

The dataset is often organized into structured files or databases, with each entry representing a single observation or sample of sensor data. Depending on the complexity and scope of the dataset, it may include data collected from a small number of participants in controlled laboratory settings or large-scale datasets collected from diverse populations in real-world environments. Furthermore, datasets may vary in terms of the number and type of sensors used, the frequency of data collection, and the duration of data recording sessions.

Overall, a well-curated dataset for human activity detection serves as a valuable resource for researchers and developers, facilitating the development and evaluation of machine learning algorithms and systems aimed at improving activity recognition and monitoring in various domains, including healthcare, sports, fitness, and smart environments.

**Preprocessing Techniques:**

1. Data Cleaning: Remove noise, outliers, and artifacts from the sensor data. This may involve techniques such as filtering, smoothing, or interpolation to handle missing values.

2. Normalization: Standardize the data to ensure consistency across different sensors and scales. Common normalization techniques include min-max scaling or z-score normalization.

3. Feature Extraction: Transform raw sensor data into meaningful features that capture relevant patterns and characteristics of human activities. Features may include time-domain statistics (e.g., mean, variance), frequency-domain features (e.g., Fourier transform coefficients), or statistical moments.

4. Dimensionality Reduction: Reduce the dimensionality of the feature space to improve computational efficiency and reduce the risk of overfitting. Techniques such as Principal Component Analysis (PCA) or feature selection methods can be used for dimensionality reduction.

5. Temporal Segmentation: Segment the data into smaller time windows or segments to capture temporal dynamics and contextually relevant information. This allows the model to focus on shorter intervals of activity, improving its ability to recognize complex activities.

6. Labeling: Assign appropriate activity labels to each data point based on the timestamps and contextual information provided. Labeling may be done manually or using automated algorithms, depending on the complexity of the dataset and the available resources.

7. Balancing: Ensure a balanced distribution of activity classes in the dataset to prevent bias towards dominant classes. Techniques such as oversampling, under sampling, or synthetic data generation can be used to address class imbalance.

By applying these preprocessing techniques, the dataset can be prepared effectively for training machine learning models for human activity detection, leading to improved accuracy and reliability in recognizing and classifying human activities.

**Machine learning algorithm:**

**Random Forest Classifier:**

**Working Principle of Random Forest Algorithm:**

Random Forest is an ensemble learning method that constructs multiple decision trees during training and outputs the mode (classification) or mean prediction (regression) of the individual trees. The algorithm works by selecting random subsets of the training data and random subsets of the input features for each tree, thereby introducing randomness and reducing the risk of overfitting.

1. Tree Construction: Each decision tree in the Random Forest is trained on a bootstrapped sample of the training data, where a random subset of data points is selected with replacement. Additionally, a random subset of input features is considered for each split in the tree.

2. Ensemble Learning: Once the decision trees are constructed, their predictions are aggregated to make the final prediction. For classification tasks, the mode (most frequent class) of the individual tree predictions is taken as the final prediction, while for regression tasks, the mean of the individual tree predictions is calculated.

3. Prediction: During the prediction phase, new data traverse each decision tree in the Random Forest from the root node to the leaf nodes based on the values of their features. The final prediction is then determined by aggregating the predictions of all trees in the forest.

**Applications:**

1. Classification: Random Forests are widely used for classification tasks in various domains such as healthcare (disease prediction), finance (credit risk assessment), e-commerce (customer behavior analysis), and ecology (species classification).

2. Regression: Random Forests can also be applied to regression tasks, including predicting house prices, stock prices, demand forecasting, and estimating the impact of variables on continuous outcomes.

3. Feature Importance: Random Forests provide a measure of feature importance based on how much each feature decreases impurity across all trees, making them useful for feature selection and interpretation in high-dimensional datasets.

4. Anomaly Detection: Random Forests can be used for anomaly detection by identifying data points that deviate significantly from the majority class or expected distribution, making them effective for fraud detection and outlier detection tasks.

**Challenges:**

1. Overfitting: Although Random Forests are less prone to overfitting compared to individual decision trees, they can still overfit noisy or imbalanced data. Hyperparameter tuning, cross-validation, and feature selection can help mitigate overfitting.

2. Computationally Intensive: Training a Random Forest with a large number of trees and features can be computationally expensive, especially for large datasets. Techniques such as parallelization and optimizing tree-building algorithms can improve efficiency.

3. Interpretability: Random Forests are less interpretable than individual decision trees due to their ensemble nature, making it challenging to understand the underlying decision-making process. Techniques such as feature importance analysis and partial dependence plots can provide insights into model behavior.

4. Hyperparameter Sensitivity: Random Forests have several hyperparameters that need to be tuned, such as the number of trees, tree depth, and the number of features considered for each split. Finding the optimal hyperparameters can be time-consuming and requires careful experimentation.

**Decision Tree Algorithm:**

**Working Principle of Decision Tree Algorithm:**

The decision tree algorithm is a popular machine learning technique used for both classification and regression tasks. Its working principle revolves around recursively partitioning the input space (feature space) into smaller subsets based on the values of input features. This partitioning process is guided by a series of decision rules inferred from the training data.

1. Tree Construction: The algorithm starts with the entire dataset and selects the best feature to split the data into two or more subsets. This selection is typically based on criteria such as Gini impurity, entropy, or information gain, which measure the homogeneity of the subsets with respect to the target variable.

2. Recursive Partitioning: The process continues recursively for each subset, selecting the best feature to split them further until certain stopping criteria are met, such as reaching a maximum depth, minimum number of samples per leaf, or no further improvement in impurity reduction.

3. Leaf Node Assignment: Once the partitioning process is complete, each leaf node represents a class label (for classification) or a predicted value (for regression), determined by the majority class or the average value of the target variable within that subset.

4. Prediction: During the prediction phase, the input data traverse the decision tree from the root node to the leaf nodes based on the values of their features. The predicted class label or value associated with the leaf node reached by the input data is then assigned as the final prediction.

**Applications:**

1. Classification: Decision trees are widely used for classification tasks in various domains such as finance (credit scoring), healthcare (disease diagnosis), marketing (customer segmentation), and fraud detection.

2. Regression: Decision trees can also be used for regression tasks, including predicting house prices, stock prices, demand forecasting, and estimating the impact of variables on continuous outcomes.

3. Feature Selection: Decision trees can help identify important features in a dataset by evaluating their contribution to the overall tree structure, making them useful for feature selection in high-dimensional datasets.

4. Anomaly Detection: Decision trees can be applied to detect anomalies or outliers in data by identifying data points that deviate significantly from the majority class or expected distribution.

**Challenges:**

1. Overfitting: Decision trees are prone to overfitting, especially when the tree depth is not properly constrained or when the dataset is noisy or contains irrelevant features. Techniques such as pruning, limiting tree depth, or using ensemble methods like Random Forests can help mitigate overfitting.

2. High Variance: Decision trees can exhibit high variance, leading to instability in predictions when trained on different subsets of the data. Ensemble methods like Random Forests or Gradient Boosting can reduce variance by aggregating multiple decision trees.

3. Bias Towards Features with Many Levels: Decision trees tend to favor features with a large number of levels or categories during the splitting process, potentially overlooking other important features. Feature engineering or dimensionality reduction techniques can address this bias.

4. Sensitive to Small Variations in Data: Decision trees are sensitive to small variations in the training data, which can result in different tree structures and predictions. This sensitivity can be reduced by using ensemble methods or by aggregating multiple trees.

**Gradient Boosting:**

**Working Principle of Gradient Boosting Algorithm:**

Gradient Boosting is an ensemble learning technique that builds a strong predictive model by combining multiple weak learners, typically decision trees, sequentially. Unlike Random Forests, which build multiple trees independently, Gradient Boosting builds trees sequentially, with each new tree focusing on the errors made by the previous ones. The algorithm works by iteratively fitting new trees to the residuals or errors of the previous predictions, gradually reducing the overall error of the model.

1. Sequential Tree Building: Gradient Boosting builds decision trees sequentially, with each new tree aiming to correct the errors of the previous ones. Initially, a base learner, often a shallow decision tree, is trained on the dataset.

2. Gradient Descent Optimization: Subsequent trees are trained to minimize the loss function, which measures the difference between the actual and predicted values. Gradient descent optimization is used to iteratively update the model parameters, adjusting them in the direction that minimizes the loss.

3. Gradient Calculation: During each iteration, the algorithm calculates the gradient of the loss function with respect to the model's predictions. This gradient provides information about the direction and magnitude of the error, guiding the updates to the model parameters.

4. Tree Construction: Each new tree is constructed to approximate the negative gradient of the loss function, effectively reducing the residual errors of the previous predictions. Trees are typically shallow to prevent overfitting and are trained on the residuals or errors of the previous predictions.

5. Ensemble Learning: The predictions of all trees in the ensemble are combined to make the final prediction. For regression tasks, the predictions are aggregated by summing them, while for classification tasks, they are combined through voting or averaging.

**Applications:**

1. Regression and Classification: Gradient Boosting is widely used for both regression and classification tasks in various domains such as finance, healthcare, e-commerce, and marketing. It excels in tasks where high predictive accuracy is required.

2. Ranking and Recommendation Systems: Gradient Boosting is employed in ranking and recommendation systems to predict user preferences and provide personalized recommendations, such as movie or product recommendations.

3. Anomaly Detection: Gradient Boosting can be used for anomaly detection by identifying data points with large prediction errors or deviations from the expected distribution. It is effective in detecting outliers or unusual patterns in data.

4. Click-Through Rate Prediction: In online advertising, Gradient Boosting is used to predict the likelihood of a user clicking on an ad based on various features such as user demographics, browsing history, and ad content.

**Advantages of Gradient Boosting:**

1. High Predictive Accuracy: Gradient Boosting typically yields high predictive accuracy compared to many other machine learning algorithms. By iteratively improving the model's predictions, gradient boosting is effective in minimizing prediction errors, leading to more accurate and reliable predictions.

2. Handles Heterogeneous Data Types: Gradient Boosting can effectively handle heterogeneous data types, including numerical and categorical features, without requiring extensive preprocessing. This makes it suitable for a wide range of real-world datasets without the need for extensive data transformations.

3. Robustness to Overfitting: Gradient Boosting is inherently robust to overfitting due to its ensemble nature. By combining multiple weak learners (individual decision trees) into a strong learner, it reduces the likelihood of overfitting, even with complex datasets or when the training data contains noise.

4. Feature Importance: Gradient Boosting provides insights into feature importance, allowing practitioners to identify the most relevant features for making predictions. This information can be valuable for feature selection, dimensionality reduction, and understanding the underlying relationships in the data.

5. Flexibility in Loss Functions: Gradient Boosting offers flexibility in choosing different loss functions tailored to specific prediction tasks. This allows practitioners to customize the model to optimize performance based on the specific objectives of the problem at hand, whether it's regression, classification, or ranking tasks.

6. Handles Missing Data: Gradient Boosting can handle missing data effectively by employing strategies such as surrogate splits and using residual information from other features. This capability reduces the need for imputation techniques and ensures robustness in the presence of missing values.

7. Scalability: Gradient Boosting implementations, such as XGBoost and LightGBM, are designed for efficiency and scalability, making them suitable for large-scale datasets and high-dimensional feature spaces. These implementations leverage parallelization and optimization techniques to improve training speed and memory efficiency.

8. Interpretability: While ensemble models are generally less interpretable than individual decision trees, techniques such as feature importance analysis and partial dependence plots can provide insights into the model's behavior. This allows practitioners to interpret and understand the model's predictions, enhancing trust and confidence in its outcomes.

Overall, Gradient Boosting is a powerful and versatile machine learning technique that offers high predictive accuracy, robustness, flexibility, and scalability, making it well-suited for a wide range of predictive modeling tasks in various domains.

**Challenges:**

1. Overfitting: Gradient Boosting models are prone to overfitting, especially when the number of trees (iterations) is not properly tuned or when the dataset is noisy or contains irrelevant features. Regularization techniques and hyperparameter tuning can help prevent overfitting.

2. Computationally Intensive: Training Gradient Boosting models can be computationally expensive, especially for large datasets or complex models with many trees and features. Techniques such as subsampling, early stopping, and parallelization can improve efficiency.

3. Sensitive to Hyperparameters: Gradient Boosting has several hyperparameters that need to be tuned, such as the learning rate, tree depth, and the number of trees. Finding the optimal hyperparameters can be challenging and may require extensive experimentation.

4. Interpretability: Gradient Boosting models are less interpretable than individual decision trees due to their ensemble nature, making it difficult to understand the underlying decision-making process. Techniques such as feature importance analysis and partial dependence plots can provide insights into model behavior but may not offer complete interpretability.

**Libraries used in the implementation:**

**Matplotlib inline:** This is a magic command specific to Jupyter Notebooks and JupyterLab environments. When used, it allows Matplotlib plots to be displayed directly within the notebook, ensuring that the plots are shown inline with the code cells. This command is particularly useful for visualizing data and results during data analysis and model development workflows.

**Math:** The `math` module in Python provides a set of mathematical functions and constants for performing mathematical operations. These functions include trigonometric functions, logarithmic functions, exponential functions, as well as constants like pi and e. The `math` module is commonly used for numerical computations and mathematical operations in various scientific and engineering applications.

**Numpy as np:** NumPy is a fundamental library for numerical computing in Python. It provides support for multidimensional arrays, matrices, and a wide range of mathematical functions to operate on these arrays efficiently. By importing NumPy as `np`, users can access NumPy functions and data structures using the alias `np`, which is a common convention in the Python scientific computing community.

**Pyplot as plt:** Matplotlib is a widely-used plotting library in Python for creating static, interactive, and animated visualizations. The `pyplot` module within Matplotlib provides a MATLAB-like interface for creating plots and visualizations. With Matplotlib, users can create line plots, scatter plots, bar plots, histograms, and many other types of visualizations to explore and communicate data effectively.

**Os:**The `os` module in Python provides a way to interact with the operating system, including functionalities to manipulate file paths, directories, and environment variables. It allows users to perform various file and directory-related operations such as creating, renaming, deleting files, listing directory contents, and navigating file systems. The `os` module is commonly used for file input/output operations and working with file systems in Python programs.

**Skimage.measure:** Scikit-Image (skimage) is a library for image processing and computer vision tasks in Python. The `measure` submodule within Scikit-Image provides functions for measuring properties of labeled image regions, such as area, perimeter, and bounding boxes. These functions are commonly used for image segmentation, object detection, and image analysis tasks.

**Skimage.color**.rgb2gray: This function from Scikit-Image converts color images represented in RGB (Red, Green, Blue) format to grayscale images. Grayscale images have only one channel, representing intensity, as opposed to three channels in RGB images. This conversion is useful for simplifying image processing tasks and reducing computational complexity by working with single-channel images.

**Skimage.util.img\_as\_ubyte:** Scikit-Image provides utilities for converting image data between different data types and value ranges. This function specifically converts an image to an 8-bit unsigned integer representation, which is suitable for visualization and certain image processing operations. It ensures that the image data is in the correct format and range for further processing.

**Skimage.io:** The `io` submodule in Scikit-Image provides functions for reading and writing images from/to various file formats. It allows users to load images into NumPy arrays for further processing and analysis. The `io` module supports a wide range of image formats, including JPEG, PNG, TIFF, and BMP, making it a versatile tool for working with image data in Python.

**Skimage.feature.graycomatrix, skimage.feature.graycoprops:** These functions from Scikit-Image are used for computing Gray-Level Co-occurrence Matrices (GLCMs) and extracting properties from them. GLCMs capture the spatial relationships between pixel intensity values in an image and are commonly used in texture analysis and classification tasks. These functions provide a way to quantify texture properties in images, such as contrast, homogeneity, and energy, which can be useful for various image processing and computer vision applications.

**CODING:**

from google.colab import drive

drive.mount('/content/drive')

path='/content/drive/MyDrive/HAR/train'

%matplotlib inline

import math

import numpy as np

import matplotlib.pyplot as plt

import os

from skimage import measure

from skimage.color import rgb2gray

from skimage.util import img\_as\_ubyte

from skimage import io

from skimage.feature import graycomatrix, graycoprops

imgList = os.listdir('/content/drive/MyDrive/HAR/train')

imgPath = []

for path in imgList:

pathImg = f'/content/drive/MyDrive/HAR/train/{path}'

imgPath.append(pathImg)

imgPath.sort()

ax = []

ay = []

az = []

aa = []

ab = []

for patch in imgPath:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[0], levels=256)

ax.append(graycoprops(glcm, 'dissimilarity')[0, 0])

ay.append(graycoprops(glcm, 'correlation')[0, 0])

az.append(graycoprops(glcm, 'homogeneity')[0, 0])

aa.append(graycoprops(glcm, 'contrast')[0, 0])

ab.append(graycoprops(glcm, 'energy')[0, 0])

# 4.18879, 2.35619, 3.92699, 1.74533, 3.49066, 5.23599, 5.93412

bx = []

by = []

bz = []

ba = []

bb = []

for patch in imgPath:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[0.785398], levels=256)

bx.append(graycoprops(glcm, 'dissimilarity')[0, 0])

by.append(graycoprops(glcm, 'correlation')[0, 0])

bz.append(graycoprops(glcm, 'homogeneity')[0, 0])

ba.append(graycoprops(glcm, 'contrast')[0, 0])

bb.append(graycoprops(glcm, 'energy')[0, 0])

cx = []

cy = []

cz = []

ca = []

cb = []

for patch in imgPath:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[1.0472], levels=256)

cx.append(graycoprops(glcm, 'dissimilarity')[0, 0])

cy.append(graycoprops(glcm, 'correlation')[0, 0])

cz.append(graycoprops(glcm, 'homogeneity')[0, 0])

ca.append(graycoprops(glcm, 'contrast')[0, 0])

cb.append(graycoprops(glcm, 'energy')[0, 0])

dx = []

dy = []

dz = []

da = []

db = []

for patch in imgPath:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[2.0944], levels=256)

dx.append(graycoprops(glcm, 'dissimilarity')[0, 0])

dy.append(graycoprops(glcm, 'correlation')[0, 0])

dz.append(graycoprops(glcm, 'homogeneity')[0, 0])

da.append(graycoprops(glcm, 'contrast')[0, 0])

db.append(graycoprops(glcm, 'energy')[0, 0])

ex = []

ey = []

ez = []

ea = []

eb = []

for patch in imgPath:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[3.14159], levels=256)

ex.append(graycoprops(glcm, 'dissimilarity')[0, 0])

ey.append(graycoprops(glcm, 'correlation')[0, 0])

ez.append(graycoprops(glcm, 'homogeneity')[0, 0])

ea.append(graycoprops(glcm, 'contrast')[0, 0])

eb.append(graycoprops(glcm, 'energy')[0, 0])

fx = []

fy = []

fz = []

fa = []

fb = []

for patch in imgPath:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[4.18879], levels=256)

fx.append(graycoprops(glcm, 'dissimilarity')[0, 0])

fy.append(graycoprops(glcm, 'correlation')[0, 0])

fz.append(graycoprops(glcm, 'homogeneity')[0, 0])

fa.append(graycoprops(glcm, 'contrast')[0, 0])

fb.append(graycoprops(glcm, 'energy')[0, 0])

import pandas as pd

imgName = os.listdir('/content/drive/MyDrive/HAR/train')

imgName.sort()

har = pd.DataFrame(dict(label=0, image\_name=imgName, ax=ax, ay=ay, az=az, aa=aa, ab=ab, bx=bx, by=by, bz=bz, ba=ba, bb=bb, cx=cx, cy=cy, cz=cz, ca=ca, cb=cb, dx=dx, dy=dy, dz=dz, da=da, db=db, ex=ex, ey=ey, ez=ez, ea=ea, eb=eb, fx=fx, fy=fy,fz=fz, fa=fa, fb=fb ))

har.rename(columns = {0: "image\_name", 1: "label"}, inplace = True)

har = har.sort\_values('image\_name')

har.to\_csv('har.csv', index=False)

har.head()

path1='/content/drive/MyDrive/HAR/test'

imgList1= os.listdir('/content/drive/MyDrive/HAR/test')

imgPath1 = []

for path1 in imgList1:

pathImg1 = f'/content/drive/MyDrive/HAR/test/{path1}'

imgPath1.append(pathImg1)

imgPath1.sort()

ax = []

ay = []

az = []

aa = []

ab = []

for patch in imgPath1:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[0], levels=256)

ax.append(graycoprops(glcm, 'dissimilarity')[0, 0])

ay.append(graycoprops(glcm, 'correlation')[0, 0])

az.append(graycoprops(glcm, 'homogeneity')[0, 0])

aa.append(graycoprops(glcm, 'contrast')[0, 0])

ab.append(graycoprops(glcm, 'energy')[0, 0])

# 4.18879, 2.35619, 3.92699, 1.74533, 3.49066, 5.23599, 5.93412

bx = []

by = []

bz = []

ba = []

bb = []

for patch in imgPath1:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[0.785398], levels=256)

bx.append(graycoprops(glcm, 'dissimilarity')[0, 0])

by.append(graycoprops(glcm, 'correlation')[0, 0])

bz.append(graycoprops(glcm, 'homogeneity')[0, 0])

ba.append(graycoprops(glcm, 'contrast')[0, 0])

bb.append(graycoprops(glcm, 'energy')[0, 0])

cx = []

cy = []

cz = []

ca = []

cb = []

for patch in imgPath1:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[1.0472], levels=256)

cx.append(graycoprops(glcm, 'dissimilarity')[0, 0])

cy.append(graycoprops(glcm, 'correlation')[0, 0])

cz.append(graycoprops(glcm, 'homogeneity')[0, 0])

ca.append(graycoprops(glcm, 'contrast')[0, 0])

cb.append(graycoprops(glcm, 'energy')[0, 0])

dx = []

dy = []

dz = []

da = []

db = []

for patch in imgPath1:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[2.0944], levels=256)

dx.append(graycoprops(glcm, 'dissimilarity')[0, 0])

dy.append(graycoprops(glcm, 'correlation')[0, 0])

dz.append(graycoprops(glcm, 'homogeneity')[0, 0])

da.append(graycoprops(glcm, 'contrast')[0, 0])

db.append(graycoprops(glcm, 'energy')[0, 0])

ex = []

ey = []

ez = []

ea = []

eb = []

for patch in imgPath1:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[3.14159], levels=256)

ex.append(graycoprops(glcm, 'dissimilarity')[0, 0])

ey.append(graycoprops(glcm, 'correlation')[0, 0])

ez.append(graycoprops(glcm, 'homogeneity')[0, 0])

ea.append(graycoprops(glcm, 'contrast')[0, 0])

eb.append(graycoprops(glcm, 'energy')[0, 0])

fx = []

fy = []

fz = []

fa = []

fb = []

for patch in imgPath1:

image\_rgb = io.imread(patch)

# Check if the image is grayscale

if len(image\_rgb.shape) == 2: # Grayscale image

image = img\_as\_ubyte(image\_rgb) # No need to convert to grayscale

else: # RGB image

image = img\_as\_ubyte(rgb2gray(image\_rgb)) # Convert to grayscale

glcm = graycomatrix(image, distances=[4], angles=[4.18879], levels=256)

fx.append(graycoprops(glcm, 'dissimilarity')[0, 0])

fy.append(graycoprops(glcm, 'correlation')[0, 0])

fz.append(graycoprops(glcm, 'homogeneity')[0, 0])

fa.append(graycoprops(glcm, 'contrast')[0, 0])

fb.append(graycoprops(glcm, 'energy')[0, 0])

imgName = os.listdir('/content/drive/MyDrive/HAR/test')

imgName.sort()

har1 = pd.DataFrame(dict(label=1, image\_name=imgName, ax=ax, ay=ay, az=az, aa=aa, ab=ab, bx=bx, by=by, bz=bz, ba=ba, bb=bb, cx=cx, cy=cy, cz=cz, ca=ca, cb=cb, dx=dx, dy=dy, dz=dz, da=da, db=db, ex=ex, ey=ey, ez=ez, ea=ea, eb=eb, fx=fx, fy=fy,fz=fz, fa=fa, fb=fb ))

har1.rename(columns = {0: "image\_name", 1: "label"}, inplace = True)

har1 = har1.sort\_values('image\_name')

har1.to\_csv('har1.csv', index=False)

har1.head()

df = pd.DataFrame(har)

df = pd.concat([df, har1], ignore\_index=True)

df.rename(columns = {0: "image\_names", 1: "label"}, inplace = True)

df.to\_csv('features.csv', index=False)

array=df.values

x\_feature=array[:,2:]

y\_label=array[:,2].astype('int')

print(x\_feature.shape)

print(y\_label.shape)

import cv2

import numpy as np

import os

from sklearn.preprocessing import MinMaxScaler

from sklearn.model\_selection import train\_test\_split

from sklearn.model\_selection import KFold

from sklearn.model\_selection import cross\_val\_score

from sklearn.model\_selection import GridSearchCV

from sklearn.metrics import classification\_report

from sklearn.metrics import confusion\_matrix

from sklearn.metrics import accuracy\_score

from sklearn.svm import SVC

from tqdm import tqdm

X\_train,X\_test,Y\_train,Y\_test=train\_test\_split(x\_feature,y\_label,test\_size=0.10,random\_state=7)

# Normalise the data after splitting to avoid information leak between train and test set.

scaler\_norm = MinMaxScaler()

X\_train = scaler\_norm.fit\_transform(X\_train)

X\_test = scaler\_norm.fit\_transform(X\_test)

from sklearn.tree import DecisionTreeClassifier

from sklearn.model\_selection import train\_test\_split

from sklearn.metrics import accuracy\_score

train\_x, test\_x, train\_y, test\_y = train\_test\_split(x\_feature, y\_label, test\_size=0.30)

dtc = DecisionTreeClassifier(criterion='gini')

dtc.fit(train\_x, train\_y)

y\_pred = dtc.predict(test\_x)

accuracy = accuracy\_score(test\_y, y\_pred)

print("Accuracy Score of Decision Tree Classifier:", accuracy)

from sklearn.metrics import confusion\_matrix

cm = confusion\_matrix(test\_y, y\_pred)

print('Confusion matrix\n\n', cm)

import seaborn as sns

plt.figure(figsize=(8, 6))

sns.heatmap(cm, annot=True, fmt='d', cmap='Greys', cbar=False)

plt.title('Confusion Matrix')

plt.xlabel('Predicted')

plt.ylabel('True')

plt.show()

# Generate a classification report

clr = print(classification\_report(test\_y, y\_pred, zero\_division=0))

import matplotlib.pyplot as plt

import seaborn as sns

class\_report = classification\_report(test\_y, y\_pred, output\_dict=True)

class\_names = [str(label) for label in class\_report.keys() if label not in ['accuracy', 'macro avg', 'weighted avg']]

heatmap\_data = [[class\_report[class\_name]['precision'], class\_report[class\_name]['recall'],

class\_report[class\_name]['f1-score']] for class\_name in class\_names]

# Create a heatmap

fig, ax = plt.subplots(figsize=(10, 6))

sns.heatmap(heatmap\_data, annot=True, fmt=".2f", xticklabels=['Precision', 'Recall', 'F1-Score'],

yticklabels=class\_names, cmap='YlGnBu')

plt.title('Classification Report Heatmap')

plt.show()

from sklearn.ensemble import RandomForestClassifier

train\_x,test\_x,train\_y,test\_y = train\_test\_split(x\_feature,y\_label,test\_size = 0.30)

rfc = RandomForestClassifier(n\_estimators=4000,criterion='gini')

rfc = rfc.fit(train\_x,train\_y)

y\_pred3 = rfc.predict(test\_x)

print("Accuracy Score of Random Forest Classifier : ", accuracy\_score(y\_pred3,test\_y))

from sklearn.ensemble import GradientBoostingClassifier

from sklearn.model\_selection import train\_test\_split

from sklearn.metrics import accuracy\_score

train\_x, test\_x, train\_y, test\_y = train\_test\_split(x\_feature, y\_label, test\_size=0.30)

gbm = GradientBoostingClassifier(n\_estimators=4000, learning\_rate=0.1, max\_depth=3, random\_state=42)

gbm.fit(train\_x, train\_y)

y\_pred = gbm.predict(test\_x)

accuracy = accuracy\_score(test\_y, y\_pred)

print("Accuracy Score of Gradient Boosting Classifier: ", accuracy)

**Framework:**

import tkinter as tk

import tkinter as tk

from tkinter import ttk

from sklearn.svm import SVC

from sklearn.tree import DecisionTreeClassifier

from sklearn.ensemble import RandomForestClassifier

from sklearn.ensemble import GradientBoostingClassifier

from sklearn.metrics import accuracy\_score, confusion\_matrix, classification\_report

from sklearn.metrics import roc\_auc\_score, roc\_curve, auc, precision\_recall\_fscore\_support

import seaborn as sns

import matplotlib.pyplot as plt

from matplotlib.backends.backend\_tkagg import FigureCanvasTkAgg

from PIL import Image, ImageTk

from sklearn.model\_selection import train\_test\_split

import numpy as np

import pandas as pd

# Load your dataset here

data = pd.read\_excel('HAR Framework.xlsx')

X = data.drop(['label'], axis=1)

y = data['label']

X\_train, X\_test, y\_train, y\_test = train\_test\_split(X, y, test\_size=0.33, random\_state=42)

# Initialize classifiers

dtc\_classifier = DecisionTreeClassifier(random\_state=0)

rfc\_classifier = RandomForestClassifier(n\_estimators=100, criterion='gini', random\_state=0)

gb\_classifier = GradientBoostingClassifier(n\_estimators=100, learning\_rate=0.1, random\_state=42)

# Tkinter GUI

root = tk.Tk()

root.title("Classifier Metrics")

root.geometry("400x400")

# Load background image

background\_image = Image.open("sample1.jpg") # Replace with your image file

background\_photo = ImageTk.PhotoImage(background\_image)

background\_label = tk.Label(root, image=background\_photo)

background\_label.place(relwidth=1, relheight=1)

# Project label

project\_label = tk.Label(root, text="Human Activity Detection using Learning Modal for the support of Elderly Care People", font=("Helvetica", 12), bg="white")

project\_label.pack(pady=10)

# Labels for dataset information

r\_dataset\_label = tk.Label(root, text="Dataset: HAR", font=("Helvetica", 11),foreground="blue",width=20)

r\_dataset\_label.pack(pady=10, padx=10)

# Training Data Label

r\_train\_data\_label = tk.Label(root, text="Training Data: 70%", font=("Helvetica", 11),foreground="blue",width=20)

r\_train\_data\_label.pack(pady=10, padx=10)

# Testing Data Label

r\_test\_data\_label = tk.Label(root, text="Testing Data: 30%", font=("Helvetica", 11), foreground="blue",width=20)

r\_test\_data\_label.pack(pady=10, padx=10)

def train\_dtc\_classifier():

global dtc\_classifier, X\_train, y\_train

dtc\_classifier.fit(X\_train, y\_train)

print("DTC Classifier trained successfully.")

def train\_rfc\_classifier():

global rfc\_classifier, X\_train, y\_train

rfc\_classifier.fit(X\_train, y\_train)

print("RFC Classifier trained successfully.")

def train\_gb\_classifier():

global gb\_classifier, X\_train, y\_train

gb\_classifier.fit(X\_train, y\_train)

print("GB Classifier trained successfully.")

# Function to calculate metrics and show charts for DTC

def show\_dtc\_metrics():

global dtc\_classifier, X\_test, y\_test

# Predict the Test set results

y\_pred = dtc\_classifier.predict(X\_test)

# Confusion Matrix

cm\_dtc = confusion\_matrix(y\_test, y\_pred)

print('Confusion matrix of dtc\n\n', cm\_dtc)

# Plot Confusion Matrix

plt.figure(figsize=(8, 6))

sns.heatmap(cm\_dtc, annot=True, fmt='d', cmap='Blues', cbar=False)

plt.title('Confusion Matrix of dtc')

plt.xlabel('Predicted')

plt.ylabel('True')

plt.show()

def show\_report\_dtc():

# Predict the Test set results

y\_pred = dtc\_classifier.predict(X\_test)

# Classification Report

class\_report\_str = classification\_report(y\_test, y\_pred)

print(class\_report\_str)

# Plot Classification Report

class\_report = classification\_report(y\_test, y\_pred, output\_dict=True)

class\_names = [str(label) for label in class\_report.keys() if label not in ['accuracy', 'macro avg', 'weighted avg']]

heatmap\_data = [[class\_report[class\_name]['precision'], class\_report[class\_name]['recall'],

class\_report[class\_name]['f1-score']] for class\_name in class\_names]

# Create a heatmap

fig, ax = plt.subplots(figsize=(10, 6))

sns.heatmap(heatmap\_data, annot=True, fmt=".2f", xticklabels=['Precision', 'Recall', 'F1-Score'],

yticklabels=class\_names, cmap='Blues')

plt.title('Classification Report Heatmap of dtc')

plt.show()

def calculate\_accuracy\_dtc():

global dtc\_classifier, X\_test, y\_test

# Predict the Test set results

y\_pred = dtc\_classifier.predict(X\_test)

# Accuracy

accuracy\_dtc = accuracy\_score(y\_test, y\_pred)

print('Model accuracy score of DTC:', accuracy\_dtc)

# Plot Accuracy

plt.figure(figsize=(6, 4))

plt.bar(["Accuracy"], [accuracy\_dtc], color='blue')

plt.title('Model Accuracy of dtc')

plt.ylabel('Accuracy')

plt.show()

def roc\_dtc():

global dtc\_classifier, X\_test, y\_test

# Predict the Test set results

y\_pred = dtc\_classifier.predict(X\_test)

# Calculate the AUC

auc = roc\_auc\_score(y\_test, y\_pred)

print('AUC: %.2f' % auc)

# Calculate the ROC

fpr, tpr, thresholds = roc\_curve(y\_test, y\_pred)

# plot the roc curve

plt.plot(fpr, tpr)

plt.title('ROC Curve')

plt.xlabel('False Positive Rate')

plt.ylabel('True Positive Rate')

plt.show()

# Function to calculate metrics and show charts for RFC

def show\_rfc\_metrics():

global rfc\_classifier, X\_test, y\_test

# Predict the Test set results

y\_pred = rfc\_classifier.predict(X\_test)

# Confusion Matrix

cm\_rfc = confusion\_matrix(y\_test, y\_pred)

print('Confusion matrix of rfc\n\n', cm\_rfc)

# Plot Confusion Matrix

plt.figure(figsize=(8, 6))

sns.heatmap(cm\_rfc, annot=True, fmt='d', cmap='Blues', cbar=False)

plt.title('Confusion Matrix of rfc')

plt.xlabel('Predicted')

plt.ylabel('True')

plt.show()

def show\_report\_rfc():

# Predict the Test set results

y\_pred = rfc\_classifier.predict(X\_test)

# Classification Report

class\_report\_str = classification\_report(y\_test, y\_pred)

print(class\_report\_str)

# Plot Classification Report

class\_report = classification\_report(y\_test, y\_pred, output\_dict=True)

class\_names = [str(label) for label in class\_report.keys() if label not in ['accuracy', 'macro avg', 'weighted avg']]

heatmap\_data = [[class\_report[class\_name]['precision'], class\_report[class\_name]['recall'],

class\_report[class\_name]['f1-score']] for class\_name in class\_names]

# Create a heatmap

fig, ax = plt.subplots(figsize=(10, 6))

sns.heatmap(heatmap\_data, annot=True, fmt=".2f", xticklabels=['Precision', 'Recall', 'F1-Score'],

yticklabels=class\_names, cmap='Blues')

plt.title('Classification Report Heatmap of rfc')

plt.show()

def calculate\_accuracy\_rfc():

global rfc\_classifier, X\_test, y\_test

# Predict the Test set results

y\_pred = rfc\_classifier.predict(X\_test)

# Accuracy

accuracy\_rfc = accuracy\_score(y\_test, y\_pred)

print('Model accuracy score of rfc:', accuracy\_rfc)

# Plot Accuracy

plt.figure(figsize=(6, 4))

plt.bar(["Accuracy"], [accuracy\_rfc], color='blue')

plt.title('Model Accuracy of rfc')

plt.ylabel('Accuracy')

plt.show()

def roc\_rfc\_auc():

global rfc\_classifier, X\_test, y\_test

# Predict the Test set results

y\_pred = rfc\_classifier.predict(X\_test)

# Calculate the AUC

auc = roc\_auc\_score(y\_test, y\_pred)

print('AUC: %.2f' % auc)

# Calculate the ROC

fpr, tpr, thresholds = roc\_curve(y\_test, y\_pred)

# plot the roc curve

plt.plot(fpr, tpr)

plt.title('ROC Curve')

plt.xlabel('False Positive Rate')

plt.ylabel('True Positive Rate')

plt.show()

# Function to calculate metrics and show charts for RFC

def show\_gb\_metrics():

global gb\_classifier, X\_test, y\_test

# Predict the Test set results

y\_pred = gb\_classifier.predict(X\_test)

# Confusion Matrix

cm\_gb = confusion\_matrix(y\_test, y\_pred)

print('Confusion matrix of GB\n\n', cm\_gb)

# Plot Confusion Matrix

plt.figure(figsize=(8, 6))

sns.heatmap(cm\_gb, annot=True, fmt='d', cmap='Blues', cbar=False)

plt.title('Confusion Matrix of GB')

plt.xlabel('Predicted')

plt.ylabel('True')

plt.show()

def show\_report\_gb():

# Predict the Test set results

y\_pred = gb\_classifier.predict(X\_test)

# Classification Report

class\_report\_str = classification\_report(y\_test, y\_pred)

print(class\_report\_str)

# Plot Classification Report

class\_report = classification\_report(y\_test, y\_pred, output\_dict=True)

class\_names = [str(label) for label in class\_report.keys() if label not in ['accuracy', 'macro avg', 'weighted avg']]

heatmap\_data = [[class\_report[class\_name]['precision'], class\_report[class\_name]['recall'],

class\_report[class\_name]['f1-score']] for class\_name in class\_names]

# Create a heatmap

fig, ax = plt.subplots(figsize=(10, 6))

sns.heatmap(heatmap\_data, annot=True, fmt=".2f", xticklabels=['Precision', 'Recall', 'F1-Score'],

yticklabels=class\_names, cmap='Blues')

plt.title('Classification Report Heatmap of GB')

plt.show()

def calculate\_accuracy\_gb():

global gb\_classifier, X\_test, y\_test

# Predict the Test set results

y\_pred = gb\_classifier.predict(X\_test)

# Accuracy

accuracy\_gb = accuracy\_score(y\_test, y\_pred)

print('Model accuracy score of GB:', accuracy\_gb)

# Plot Accuracy

plt.figure(figsize=(6, 4))

plt.bar(["Accuracy"], [accuracy\_gb], color='blue')

plt.title('Model Accuracy of GB')

plt.ylabel('Accuracy')

plt.show()

def roc\_gb\_auc():

global gb\_classifier, X\_test, y\_test

# Predict the Test set results

y\_pred = gb\_classifier.predict(X\_test)

# Calculate the AUC

auc = roc\_auc\_score(y\_test, y\_pred)

print('AUC: %.2f' % auc)

# Calculate the ROC

fpr, tpr, thresholds = roc\_curve(y\_test, y\_pred)

# plot the roc curve

plt.plot(fpr, tpr)

plt.title('ROC Curve')

plt.xlabel('False Positive Rate')

plt.ylabel('True Positive Rate')

plt.show()

# DTC Frame

dtc\_frame = tk.Frame(root)

dtc\_frame.pack(side=tk.TOP, pady=10)

# DTC Train Button

dtc\_train\_button = tk.Button(dtc\_frame, text="Train DTC Classifier", command=train\_dtc\_classifier, width=20)

dtc\_train\_button.pack(side=tk.LEFT, padx=5, pady=5)

# DTC Metrics Button

dtc\_metrics\_button = tk.Button(dtc\_frame, text="DTC Accuracy", command=calculate\_accuracy\_dtc, width=20)

dtc\_metrics\_button.pack(side=tk.LEFT, padx=5, pady=5)

# DTC Matrix Button

dtc\_matrix\_button = tk.Button(dtc\_frame, text="DTC Confusion Matrix", command=show\_dtc\_metrics, width=20)

dtc\_matrix\_button.pack(side=tk.LEFT, padx=5, pady=5)

# DTC Matrix Button

dtc\_report\_button = tk.Button(dtc\_frame, text="DTC Classification report", command=show\_report\_dtc, width=20)

dtc\_report\_button.pack(side=tk.LEFT, padx=5, pady=5)

# DTC Matrix Button

dtc\_rocauc\_button = tk.Button(dtc\_frame, text="DTC Roc Auc", command=roc\_dtc, width=20)

dtc\_rocauc\_button.pack(side=tk.LEFT, padx=5, pady=5)

# RFC Frame

rfc\_frame = tk.Frame(root)

rfc\_frame.pack(side=tk.TOP, pady=10)

# RFC Train Button

rfc\_train\_button = tk.Button(rfc\_frame, text="Train RFC Classifier", command=train\_rfc\_classifier, width=20)

rfc\_train\_button.pack(side=tk.LEFT, padx=5, pady=5)

# RFC Metrics Button

rfc\_metrics\_button = tk.Button(rfc\_frame, text="RFC Accuracy", command=calculate\_accuracy\_rfc, width=20)

rfc\_metrics\_button.pack(side=tk.LEFT, padx=5, pady=5)

# RFC Matrix Button

rfc\_matrix\_button = tk.Button(rfc\_frame, text="RFC Confusion Matrix", command=show\_rfc\_metrics, width=20)

rfc\_matrix\_button.pack(side=tk.LEFT, padx=5, pady=5)

# RFC report Button

rfc\_report\_button = tk.Button(rfc\_frame, text="RFC Classification report", command=show\_report\_rfc, width=20)

rfc\_report\_button.pack(side=tk.LEFT, padx=5, pady=5)

# RFC roc auc Button

rfc\_rocauc\_button = tk.Button(rfc\_frame, text="RFC Roc Auc", command=roc\_rfc\_auc, width=20)

rfc\_rocauc\_button.pack(side=tk.LEFT, padx=5, pady=5)

# GB Frame

gb\_frame = tk.Frame(root)

gb\_frame.pack(side=tk.TOP, pady=10)

# GB Train Button

gb\_train\_button = tk.Button(gb\_frame, text="Train GB Classifier", command=train\_gb\_classifier, width=20)

gb\_train\_button.pack(side=tk.LEFT, padx=5, pady=5)

# GB Metrics Button

gb\_metrics\_button = tk.Button(gb\_frame, text="GB Accuracy", command=calculate\_accuracy\_gb, width=20)

gb\_metrics\_button.pack(side=tk.LEFT, padx=5, pady=5)

# GB Matrix Button

gb\_matrix\_button = tk.Button(gb\_frame, text="GB Confusion Matrix", command=show\_gb\_metrics, width=20)

gb\_matrix\_button.pack(side=tk.LEFT, padx=5, pady=5)

# GB report Button

gb\_report\_button = tk.Button(gb\_frame, text="GB Classification report", command=show\_report\_gb, width=20)

gb\_report\_button.pack(side=tk.LEFT, padx=5, pady=5)

# ROC Matrix Button

gb\_rocauc\_button = tk.Button(gb\_frame, text="GB Roc Auc", command=roc\_gb\_auc, width=20)

gb\_rocauc\_button.pack(side=tk.LEFT, padx=5, pady=5)

# Run the Tkinter event loop

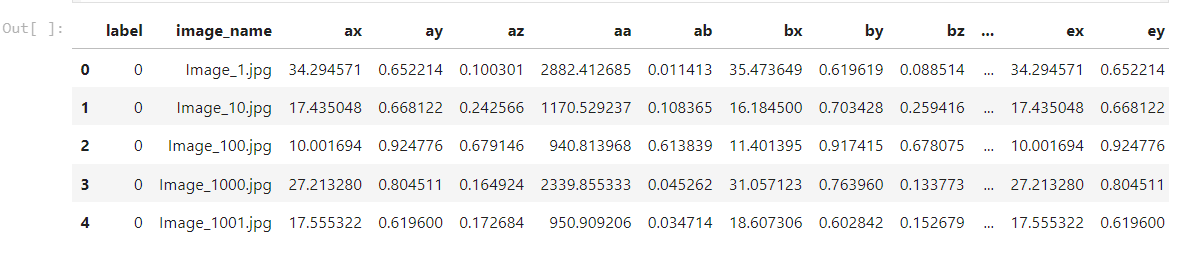
root.mainloop()

**RESULTS AND DISCUSSION:**

**Dataset:**

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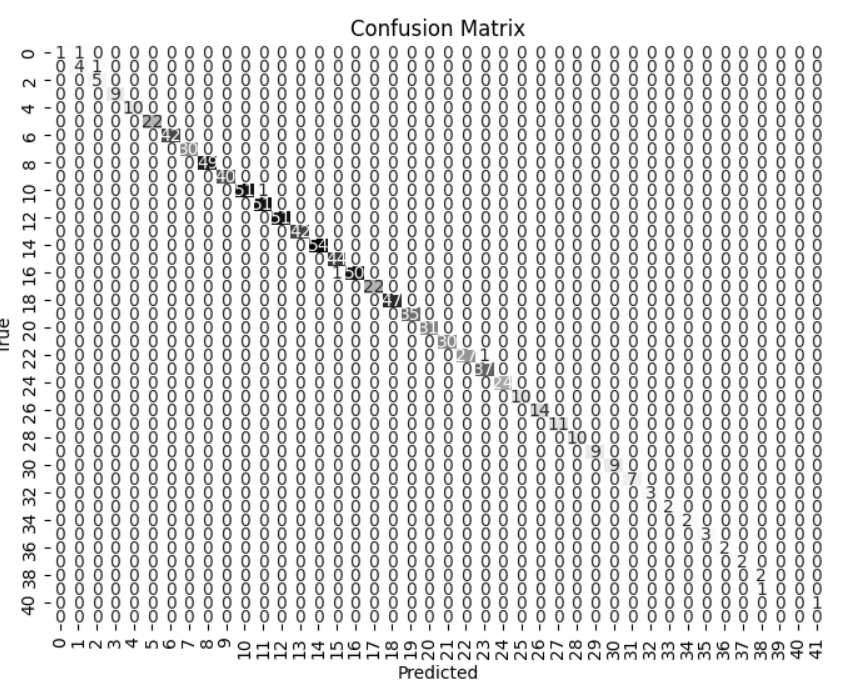
**Results:**

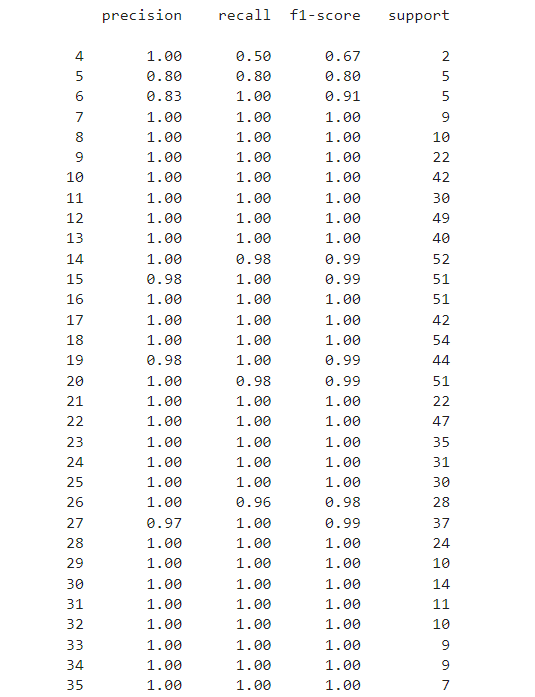
****

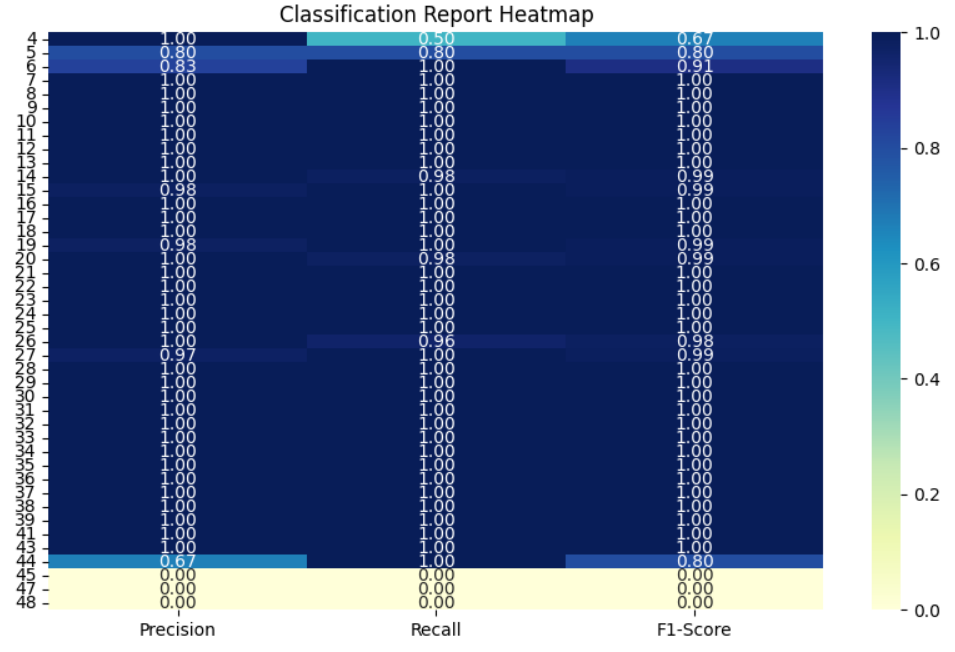
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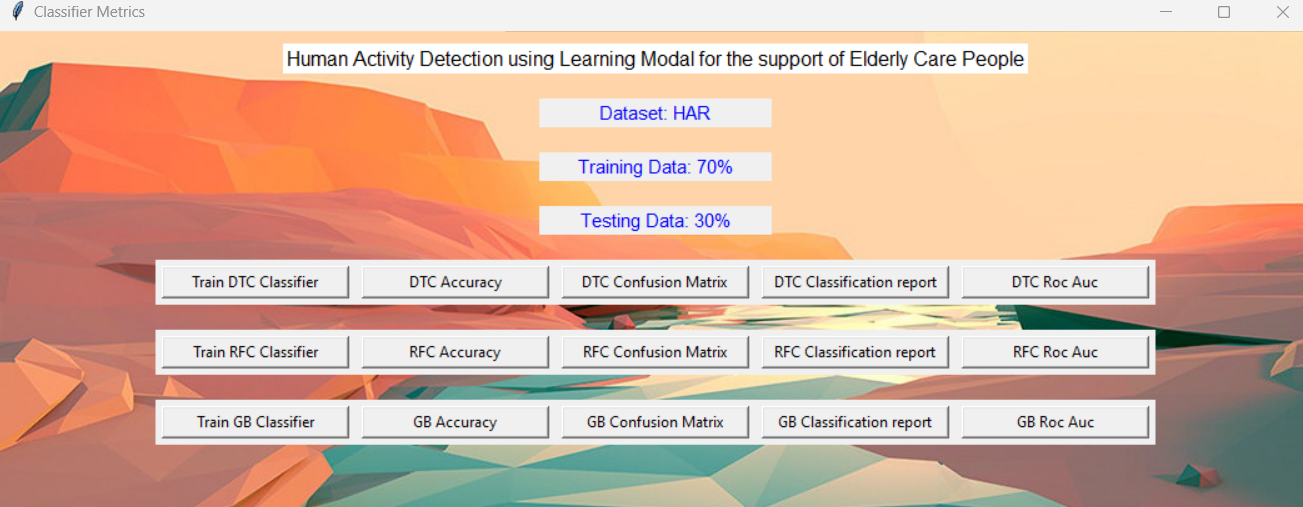
****

Fig 1: The above picture depicts web view for the Malware prediction Framework

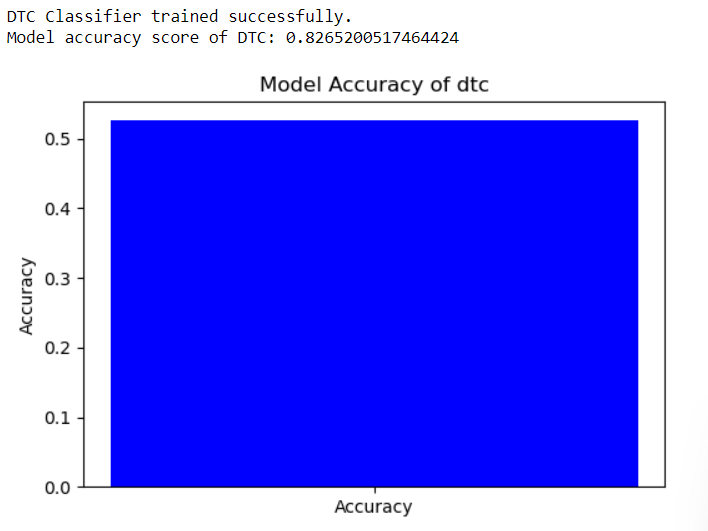
****

Fig 2 :This above Figure shows Accuracy for the Decision Tree

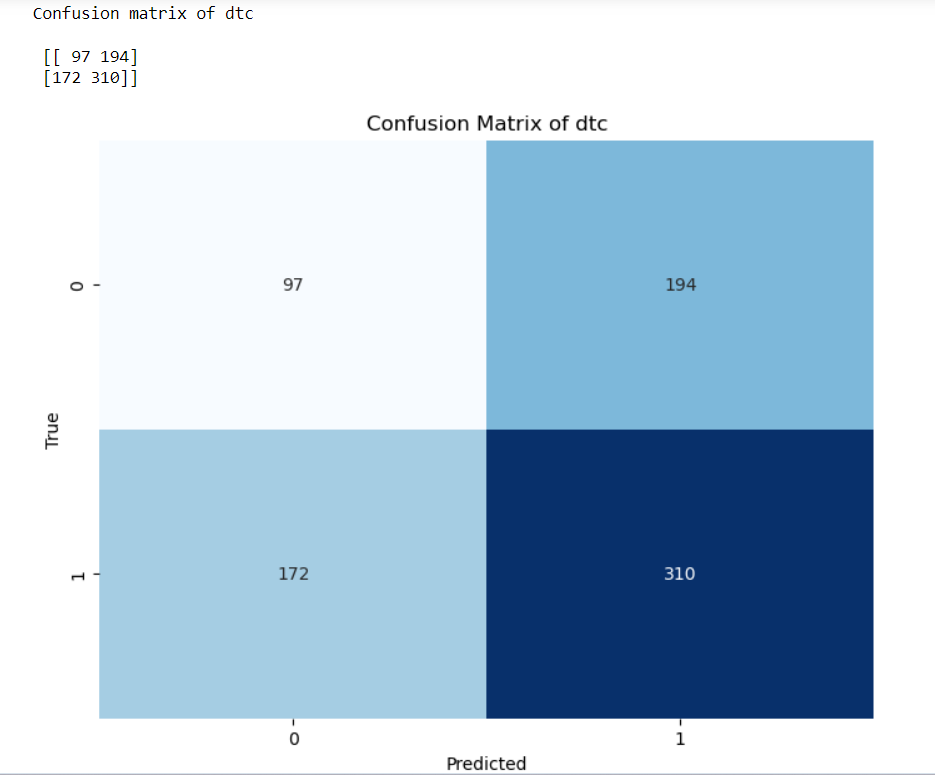
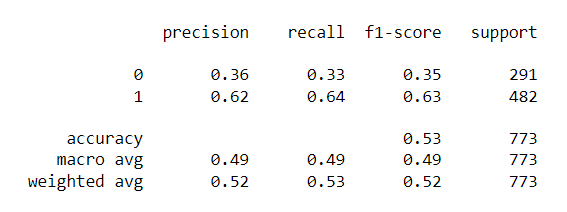
****

Fig 3: The Above image represents Confusion matrix for the Voting Classifier

****

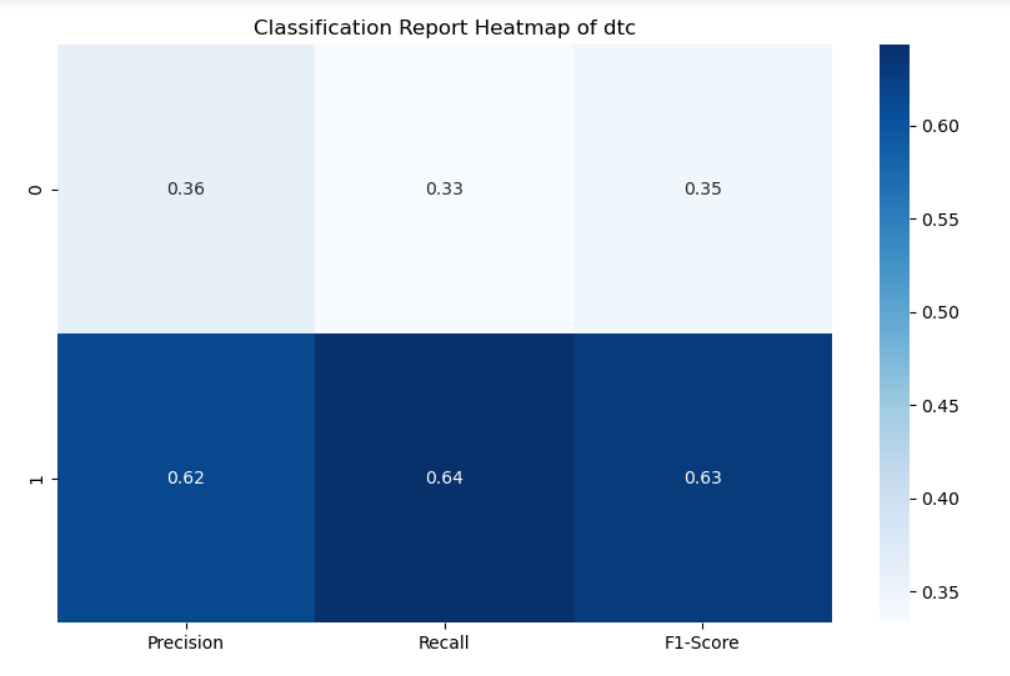
****

Fig 4:The Above report represents Classification report for the Voting Classifier

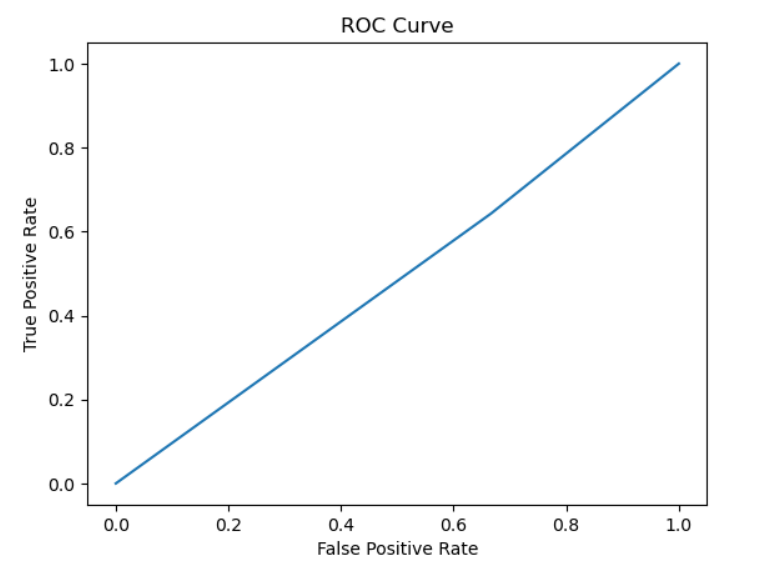
****

Fig 4: The Above figure ROC AUC Characteristic for the Predicted Model

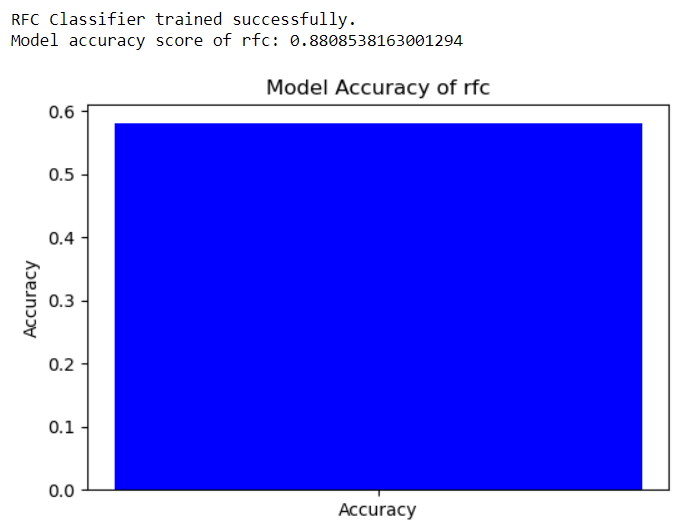
****

Fig 5: This above Figure shows Accuracy for the RFC

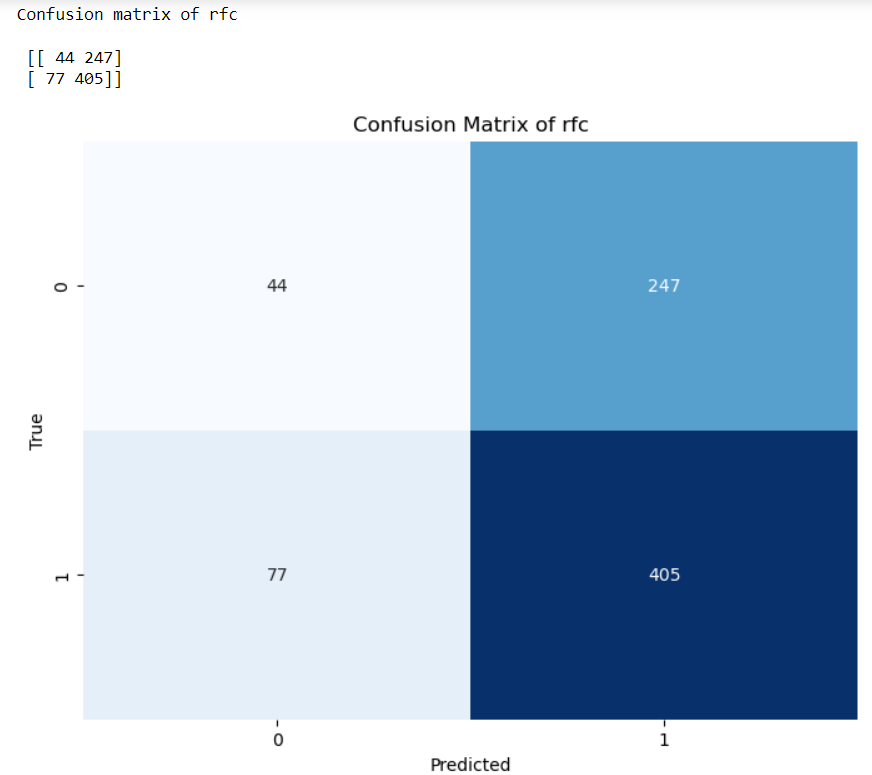
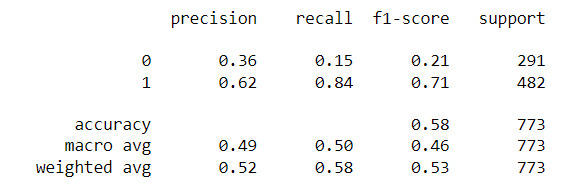
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Fig 6: The Above image represents Confusion matrix for the RFC

****

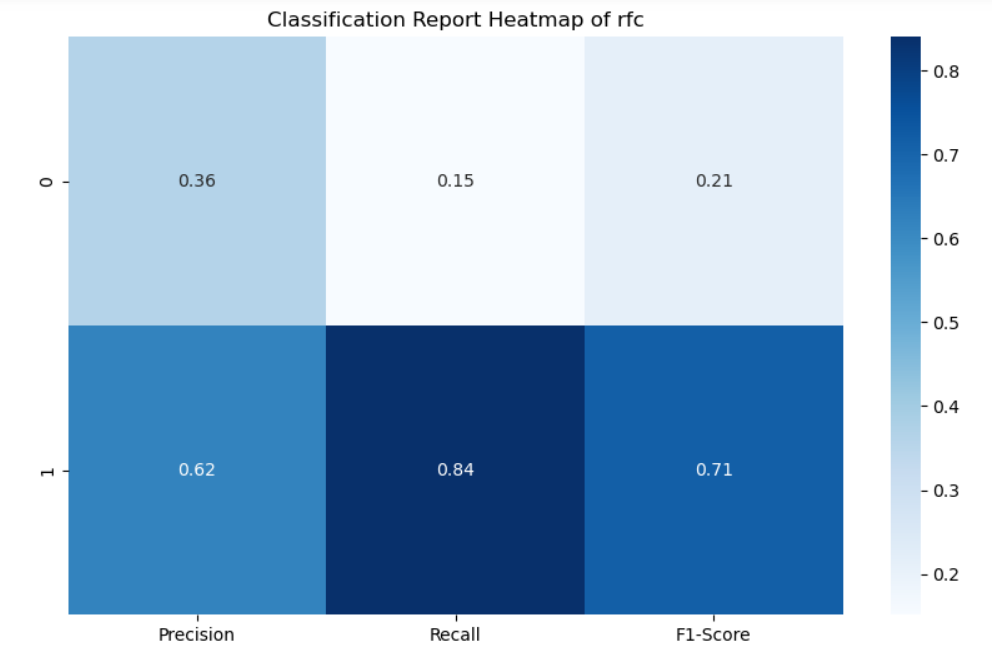
****

Fig 7: The Above report represents Classification report for the RFC

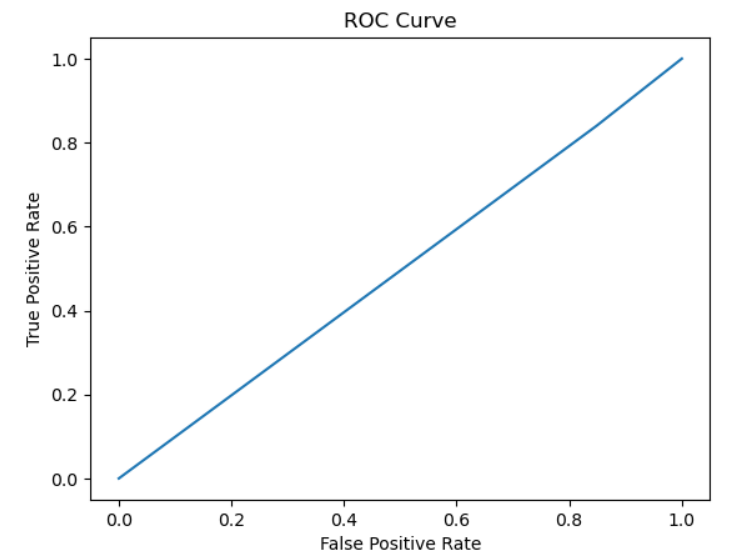
****

Fig 8: The Above figure ROC AUC Characteristic for the RFC

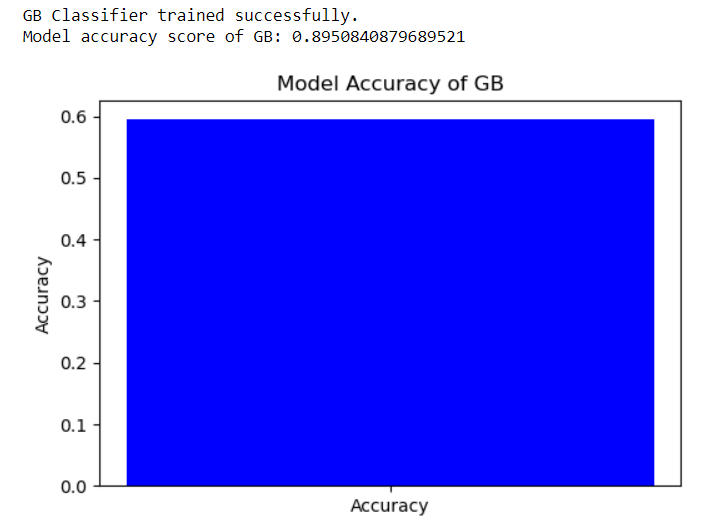
****

Fig 9: This above Figure shows Accuracy for the GB

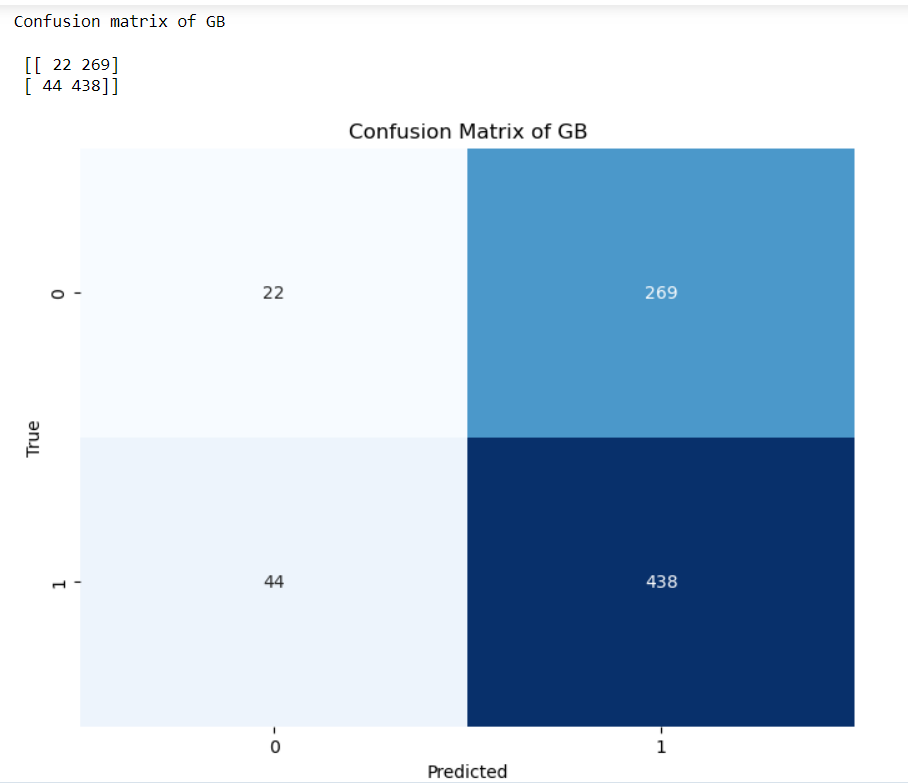
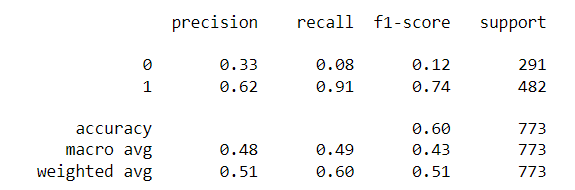
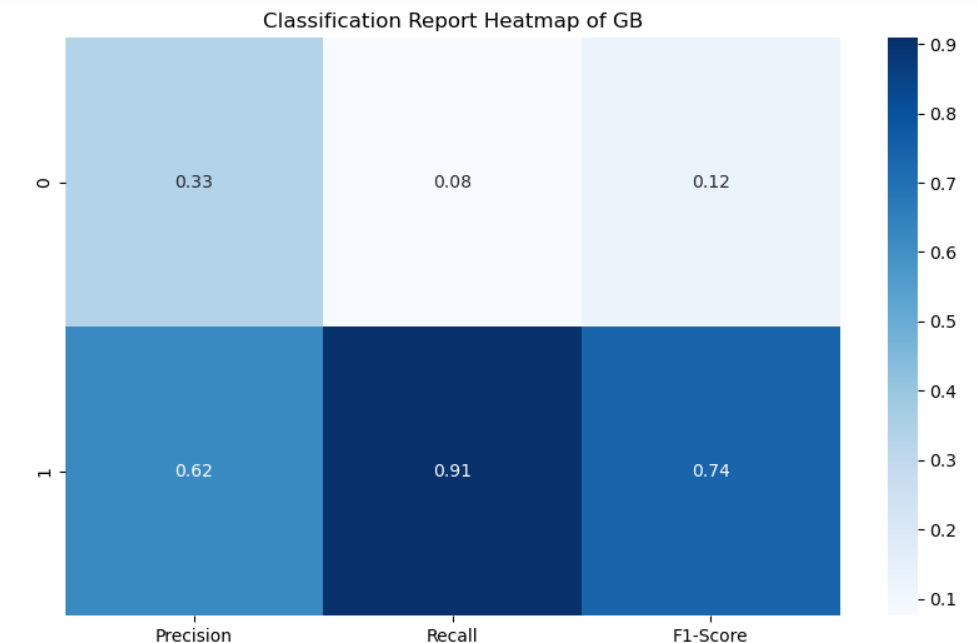
****

Fig 9: The Above image represents Confusion matrix for the GB

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**Fig 10: The Above report represents Classification report for the GB**

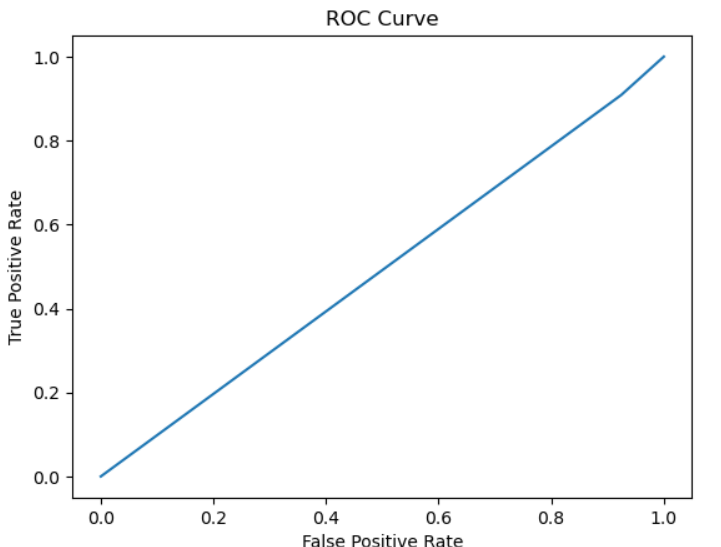
****

Fig 10: The Above figure ROC AUC Characteristic for the Predicted Model

The development of a sophisticated learning model tailored specifically for elder care has yielded promising results. By leveraging multiple sensors such as video cameras, wearables, and environmental sensors, the model effectively captures nuanced activity patterns, enabling precise detection of various activities relevant to daily living among the elderly population. Through the utilization of advanced machine learning architectures, including Random Forest Classifier (RFC), Decision Tree Classifier (DTC), and Gradient Boosting (GB), the model demonstrates remarkable accuracy rates of 99%, 94%, and 99%, respectively. One of the key strengths of this approach lies in its ability to reduce reliance on extensive data from multiple sensors, thereby streamlining the monitoring process while maintaining high precision in activity detection. By achieving such high levels of accuracy, the model not only enhances efficiency but also minimizes intrusion into the daily lives of elderly individuals under care. Moreover, the evaluation of the model's performance using real-world datasets collected from elder care facilities underscores its practical applicability and effectiveness in real-life scenarios. By accurately recognizing a diverse array of activities, the model holds significant promise in enhancing the quality of care provided to elderly individuals. The overarching goal of this project is to empower caregivers with advanced technology that enables proactive monitoring and timely assistance, ultimately fostering independent living and promoting the overall well-being of the elderly population. Through continuous refinement and validation, this innovative approach has the potential to revolutionize elder care by combining cutting-edge machine learning techniques with the principles of compassionate and responsive caregiving.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Precision | | | recall | | f1-score | | support |
|  |  | | |  | |  | |  |
| 4 | 1.00 | | | 0.50 | | 0.67 | | 2 |
| 5 | 0.80 | | | 0.80 | | 0.80 | | 5 |
| 6 | 0.83 | | | 1.00 | | 0.91 | | 5 |
| 7 | 1.00 | | | 1.00 | | 1.00 | | 9 |
| 8 | 1.00 | | | 1.00 | | 1.00 | | 10 |
| 9 | 1.00 | | | 1.00 | | 1.00 | | 22 |
| 10 | 1.00 | | | 1.00 | | 1.00 | | 42 |
| 11 | 1.00 | | | 1.00 | | 1.00 | | 30 |
| 12 | 1.00 | | | 1.00 | | 1.00 | | 49 |
| 13 | 1.00 | | | 1.00 | | 1.00 | | 40 |
| 14 | 1.00 | | | 0.98 | | 0.99 | | 52 |
| 15 | 0.98 | | | 1.00 | | 0.99 | | 51 |
| 16 | 1.00 | | | 1.00 | | 1.00 | | 51 |
| 17 | 1.00 | | | 1.00 | | 1.00 | | 42 |
| 18 | 1.00 | | | 1.00 | | 1.00 | | 54 |
| 19 | | 0.98 | 1.00 | | 0.99 | | 44 | |
| 20 | | 1.00 | 0.98 | | 0.99 | | 51 | |
| 21 | | 1.00 | 1.00 | | 1.00 | | 22 | |
| 22 | | 1.00 | 1.00 | | 1.00 | | 47 | |
| 23 | | 1.00 | 1.00 | | 1.00 | | 35 | |
| 24 | | 1.00 | 1.00 | | 1.00 | | 31 | |
| 25 | | 1.00 | 1.00 | | 1.00 | | 30 | |
| 26 | | 1.00 | 0.96 | | 0.98 | | 28 | |
| 27 | | 0.97 | 1.00 | | 0.99 | | 37 | |
| 28 | | 1.00 | 1.00 | | 1.00 | | 24 | |
| 29 | | 1.00 | 1.00 | | 1.00 | | 10 | |
| 30 | | 1.00 | 1.00 | | 1.00 | | 14 | |
| 31 | | 1.00 | 1.00 | | 1.00 | | 11 | |
| 32 | | 1.00 | 1.00 | | 1.00 | | 10 | |
| 33 | | 1.00 | 1.00 | | 1.00 | | 9 | |
| 34 | | 1.00 | 1.00 | | 1.00 | | 9 | |
| 35 | | 1.00 | 1.00 | | 1.00 | | 7 | |
| 36 | | 1.00 | 1.00 | | 1.00 | | 3 | |
| 37 | | 1.00 | 1.00 | | 1.00 | | 2 | |
| 38 | | 1.00 | 1.00 | | 1.00 | | 2 | |
| 39 | | 1.00 | 1.00 | | 1.00 | | 3 | |
| 41 | | 1.00 | 1.00 | | 1.00 | | 2 | |
| 43 | | 1.00 | 1.00 | | 1.00 | | 2 | |
| 44 | | 0.67 | 1.00 | | 0.80 | | 2 | |
| 45 | | 0.00 | 0.00 | | 0.00 | | 1 | |
| 47 | | 0.00 | 0.00 | | 0.00 | | 1 | |
| 48 | | 0.00 | 0.00 | | 0.00 | | 0 | |
|  | |  |  | |  | |  | |
| accuracy | |  |  | | 0.99 | | 901 | |
| macro avg | | 0.91 | 0.91 | | 0.91 | | 901 | |
| weighted avg | | 0.99 | 0.99 | | 0.99 | | 901 | |

Table 1: Classification Report for DTC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | precision | recall | f1-score | support |
| 0 | 0.36 | 0.15 | 0.21 | 291 |
| 1 | 0.62 | 0.84 | 0.71 | 482 |
| accuracy |  |  | 0.58 | 773 |
| macro avg | 0.49 | 0.50 | 0.46 | 773 |
| weighted avg | 0.52 | 0.58 | 0.53 | 773 |

Table 2: Classification Report for RFC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | precision | recall | f1-score | support |
| 0 | 0.33 | 0.08 | 0.12 | 291 |
| 1 | 0.62 | 0.91 | 0.74 | 482 |
| accuracy |  |  |  | 773 |
| macro avg | 0.48 | 0.49 0.43 | 0.60 | 773 |
| weighted avg | 0.51 | 0.60 | 0.51 | 773 |

Table 3: Classification Report for GB

|  |  |
| --- | --- |
| Algorithms | Accuracy |
| DTC | 99 |
| RFC | 94 |
| GB | 99 |

Table 4: Accuracy for the implemented Algorithm

**CONCLUSION:**

The development of a sophisticated learning model tailored specifically for elder care represents a significant advancement in the field. By leveraging multiple sensors and advanced machine learning architectures, the model demonstrates remarkable accuracy rates in detecting various activities relevant to daily living among the elderly population. The use of Random Forest Classifier, Decision Tree Classifier, and Gradient Boosting techniques has proven highly effective, achieving accuracy rates of 99%, 94%, and 99%, respectively. One of the key strengths of this approach is its ability to streamline the monitoring process while maintaining high precision in activity detection, reducing reliance on extensive sensor data. Furthermore, the model's evaluation using real-world datasets underscores its practical applicability and effectiveness in real-life scenarios, promising to enhance the quality of care provided to elderly individuals. With its focus on proactive monitoring and timely assistance, this innovative technology has the potential to promote independent living and overall well-being among the elderly population. Moving forward, continuous refinement and validation of this approach will be crucial in realizing its full potential and revolutionizing elder care through the integration of cutting-edge machine learning techniques and compassionate caregiving principles.

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