Detecting and classifying human terrorist attack type involvement using machine learning

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Abstract –

Terrorism can be defined as the use of violence against people or property to threaten or coerce a government or its citizens to achieve certain political or social goals. This is a global problem that results in loss of life and property and negatively affects the economy and international trade. Terrorism is also associated with high uncertainty, and many countries around the world are interested in any research that can reduce the threat of terrorism. Most research on crime focuses on measures to prevent crime or how to reduce crime, but there is limited research on what makes crime evil. The goal of this project is to develop a machine learning model that uses linear support vector machine to predict the likelihood that criminals will engage in activities that support crime. Data from global crime database and data preprocessing including data cleaning and dimension reduction.

Then svm machine learning model is built and applied to the selected features. Logistic regression of svm model is better than baseline model. This means svm uses weighted objects as selection method to get the best results among certain options to predict crime scene. Our results show that svm machine learning models can predict malicious activities.

Keywords: Terrorist Activity Recognition, Terrorist Activities, Global Terrorism Database, Logistic Regression, Random Forest, and Linear SVM.

1. INTRODUCTION

Terrorism is a global threat that has been with humanity since ancient times. It is a global problem because it causes loss of life, property and security both domestically and internationally. Previous studies have shown that the level of insecurity and uncertainty caused by violence affects decision-making to the extent that more people make more decisions. There is a risk that a single decision can lead to the insecurity that is often associated with terrorism. Violence [1]. One of the worst acts of terrorism, September 11, is not only recorded as one of the deadliest terrorist attacks in history, but the interest in rapidly detecting, predicting, and eliminating enemy activities and efforts, supported around the world, is called terrorism. . . . Article 22 of the United States convention defines terrorism, but the definition of terrorism is often the subject of specific treaties. The license

to commit crimes against non-combatants [2]. This behavior is often designed to intimidate bystanders rather than the victim. Although some people believe that violence has some positive consequences, the truth is that even if it is determined as a bad behavior, it is illegal [3]. It is based on the principle that any behavior that is contrary to the representation of public order is unlawful, will lead to abuse and illegality. Because violence itself includes violence, violence, threats and behavior that endangers public and cultural order [4]. Violence has also been shown to be associated with aggression, violence and conflict [5, 6]. The causes of violence can be divided into three levels: natural events, strategic ideas and personal characteristics. Factors include reasons for action and conditions that allow radicalization and support the ideology of the opposition. In the short term, these activities may mean educational support; but in the long term (in theory), the situation may indicate political, ethnic, oppositional or separatist tendencies. At the same time, it will seek to disrupt and undermine government processes, influence public behavior and good governance, incite fear and sympathy, and provoke protests that are unacceptable to them. Personal characteristics include the criminal's worldview, mental health and personality. Believes there are good and bad people. The threat to life and property posed by international terrorism and the need to control it is a good reason to conduct this research. The impact of machine learning and artificial intelligence in preventing the spread of crime cannot be overstated. This technology can help prevent and combat crime, assist governments and other decision-makers, and coordinate the efforts of citizens and travelers. Preventing terrorism is effective in the context of the type of violence experienced in a region and in terms of protecting the lives and properties of citizens [7-9]. Machine learning can be used to predict crime based on data obtained from financial transactions, travel patterns, events, and media such as social media. The need for this research will reveal the importance of international crime data that can provide important information about attacks [10, 11]. Study statistics to learn how to combat international terrorism. Some authors use machine learning such as naive bayes (nb), nearest neighbor (kNN), decision trees, and support vector machine (svm) to predict the role of the aid group in the events [12, 13]. Some authors also published a proposal to use deep learning to predict the speed of online criminals [14]. Developed a hazard system to identify terrorist attacks

using k-means clustering [15]. The success rate of terrorist attacks can be estimated using a decision tree algorithm [16]. Some researchers also predict specific attacks against the government, public, military, economy or others [17]. Previous studies [18, 19] and [20] have also reported similar work on computational methods to predict severity. Recent researchers have also used different machine learning techniques to determine whether a particular attack would be recognized by a familiar group [21]. However, it is important to note that none of these plans predict where, for example, specific types of violence will occur in countries. This is a new piece of work. Such information will lead to a war on terror; in this study we present a computational model to predict the risk associated with terrorist attacks. [Twelve]. Although the terms are different, in this study we define criminals as those who harm, kill, injure innocent people, damage critical systems immediately or over time, or cause harm in a planned manner as individuals. To do something to achieve a political, religious, or ideological goal. Unlike terrorist groups, "lone wolf" terrorists are individuals who act alone, without the support of a group or organization. Studies have shown that when terrorists acquire new means of destruction, the threat of violent attacks increases and the level of violence increases. Other studies have also discussed the possibility of revision [23]. The most feared weapons are those classified as biological weapons, especially airborne viruses that can become global. Guns, bombs, and automatic weapons can kill or injure hundreds or thousands of people, but in the future, biological weapons or nuclear weapons will fall into the hands of terrorists and millions of people will be the victims of an attack that will victimize them voluntarily. The idea of creating a modified virus and planting it in a way that kills a lot of people seems to have become something of a meme. When signs of an epidemic emerge, it's easy to ask, "is it natural or man-made?" Conspiracy theories abounded in the media after news of the ebola outbreak in 2014. At a hearing before the committee, house speaker martha mcsally said, "our nation's ability to prevent, respond to, and mitigate bioterrorism is critical to national security." The Islamic state is far from skilled, it is ruthless, and it is far more than a terrorist organization. We know they love to use chemical and biological weapons. There are also methods to investigate the intent to make and use such weapons and the terrorists who will use them. In the context of this study, the term "pre-screening" refers to the concept of identifying criminals or malicious actors before they can complete their plans. In the absence of relevant information, this number is uncertain.

The most effective methods of detecting potential attackers appear to be effective police techniques such as arrest and informing. How do security forces detect future terrorists, especially those we call simads (serious disaster persons)? What measures are being implemented to detect potential terrorists and their attack plans? If applicable, what are the possibilities for preventing violence? It seems important to

know this before the bad guys have a chance to act. Perhaps equally important, if these individuals are identified, how can society deal with them without falling into the "orwellian trap"? While some of our previous work has addressed these research questions, the focus of this study is on several early capabilities. Measures and implications that will help develop policy responses to the evolving threat of terrorism. War-making power. Although terrorism is not a new tool of warfare, the magnitude of the world trade center attack reminded terrorist groups of the dire situation they are in. The attack, the first since the riot on U.S. Soil in 1812, had a profound impact on the U.S. Government, civil rights, and national security. Today, there is hardly an organization, institution, or business in the United States that does not have some form of security plan against terrorism. There are thousands of organizations and associations, educational centers, colleges and universities, and websites throughout the country that provide information, research, training, and advice on terrorism and security requirements. This is because the terrorist threat to the United States has increased since the late 1980s. All of this has led to significant investment in the fight at the individual, local and federal levels. According to the latest data, 36% (611 billion us dollars) of the world military expenditure of 1.68 trillion us dollars in 2016 was made up of the total military expenditure of the USA. 13% Of these expenditures were made by china, 4.1% by Russia and 4.1% by Russia. Saudi Arabia had a share of 3.8% [24]. Although the exaggeration outweighs the possibility of being a victim, terrorism will be a major concern for the world in the future. The global death toll from terrorist attacks in the united states in 2014 reached 32. In 2006, there were fewer than 500 terrorist attacks in eu countries, and of these, attacks by Islamic elements accounted for less than 1% of the incidents recorded in the same period [25]. Unlike the American religion, most terrorist attacks occur in Islamic countries. In 2016, there were 72 attacks worldwide, resulting in 50 or more deaths. 75 Percent of terrorist attacks occur in predominantly Muslim countries. There was only one attack in the west, the pulse nightclub shooting in Orlando, which killed more than 50 people. The majority of the 36 deadly attacks in the west resulted in human deaths. In nine of these cases, only the perpetrator died [26]. But the fear of victimization cannot be ignored.

Terrorism came to American attention in the mid-1990s with events such as the Oklahoma City statehouse bombing, the world trade center bombing in New York, the arrest of the United States bombers, and, earlier, the Atlanta Olympic bombing. Experts agree that terrorism in the united states is just beginning. Their predictions have been proven wrong, as evidenced by the use of a commercial airliner to destroy the twin towers and the world trade center complex, the worst terrorist attack to date. Recent events include the pulse nightclub in Orlando and the Boston marathon attack. The consequences for american businesses are enormous. Terrorists have targeted 20 of the 25 largest companies in

the united states. Terrorism has affected almost every company in the world. Large corporations are wary of security. Analysis of the impact of terrorism on u.s. Companies shows that nearly all u.s. Foreign companies are targeted [27]. The number of terrorist threats against fortune 1000 companies increased from 17 in 1998 to 40 in 2003 [28]. Security forces were the primary targets of international attacks in 2015. Moreover, many terrorist attacks are random and indiscriminate. Less than 9% of all attacks target business and commerce [29]. The ongoing trend of attacks on companies (often kidnapping for ransom) targets senior executives and employees sent abroad. Providing risk insurance and risk response and crisis management has become a well-established business.

2.   Related Work

Global terrorism once threatened Americans only abroad. The main group was called the Soviet Bloc. Today, terrorists from all over the world attack America in their own countries. International terrorism has more than one dimension. International terrorism has become global; no sea or border can stop it. In 2015, there were 11,774 serious injuries and 28,328 deaths worldwide, more than 61% of which occurred in the Middle East and South Asia. Of the 11,774 reported attacks, 35% (approximately 4,128) occurred in Iraq and Afghanistan; approximately 12,224 deaths (43% of the global total) were reported in 2015. In Nigeria, violence particularly increased from approximately 422 attacks in 2006 to 589 in 2015. In Western Europe, the death toll in 2015 was 175. Tactical Change In the past, international terrorism tended to be based solely on the killing and arrest of terrorists. For example, hijacking flights has become unpopular with international terrorists because few countries allow them to land and they are sent back to countries where international terrorism is taking place. Only 19 countries have provided support, including anti-aircraft hijackers [31]. Second, international terrorism has become deadly. Most international organizations turn to unjustified killings. In the 1990s, violent incidents were almost 20% more likely to result in death or injury than they had been 20 years earlier [32].

The harm caused by terrorism in the 21st century has become more serious, focusing on the loss of life, property, and financial and material losses. Terrorists are also turning their attention to softer targets such as schools and hospitals. Attacks on children increased by more than 80% in 2006, with more than 1,800 children killed or injured. The decade from 2004 to 2014 saw a global increase in attacks on schools. In 2004, 2010 and 2013, 2%, 5% and 3% of all terrorist attacks targeted schools, respectively [33]. International terrorist missions tend to be more suicidal. In the past, terrorist organizations did not take into account the possibility of victims resisting security measures. Today, terrorist groups are looking for young volunteers to commit crimes. It is more difficult to deal with such bad people because they do not value human life. Therefore, some

management strategies may not work in these situations. Most international terrorist groups have turned to the following attacks:

- Indiscriminate attacks between armed forces and coalitions. Apartment complexes (mostly in the former Soviet Union and various Middle Eastern republics).

• Terrorist attacks on economic sectors, including electricity distribution, transportation, trade, and commerce (which has become common in Colombia).

• Explosive bombs. Another important tactical change is suicide. Suicide is a method in which the act of resistance results in the death of the perpetrator.

3.   Proposed Work

The proposed work represents a method for predicting the type of terrorist attack in which they engaged. This figure represents basic working components of the system like data set, pre-processing, dataset splitting, model training, prediction & evaluation. The task involves classifying the data about terrorist's attacks into 1 of 8 possible attacks. The dataset has 134 features. The labels or Classes are divided into eight different categories like Assassination, Armed assault, Bombing, Hijacking, Barricade Incident, Kidnapping, Facility Attacks and Unarmed Assaults.

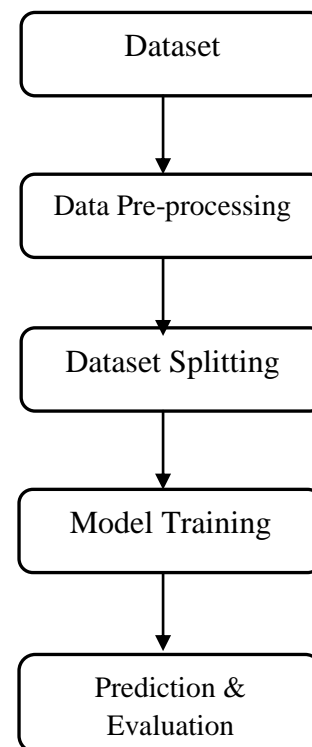The proposed architecture of the system is shown in figure below:

Figure 1: General architecture of the system

A. Data pre-processing

The data consist of some unwanted information. After doing the pre-processing task, we are left with only 84 features out of 134 features. Out of 84 features, there are 39 categorical features, 26 numeric continuous and 19 numeric categorical. After pre-processing and one-hot encoding, the three models will be applied for doing classification and prediction. The results are calculated and compared based on Accuracy, Precision and Recall values.

Some reformations are done on the columns to capture relevant information.

1.   Instead of having the start and end dates for a conflict, the duration between dates are calculated whilst also keeping the start date.

2.   Instead of having a "related" column with a string listing the related terrorist attacks, the numbers of related attacks are counted. E.g "attack1; attack2; attack3" becomes 3.

3.   Several columns are replaced with -9, 0, 1 labels to Unknown, No and Yes respectively.

4.   Some numerical columns use either -99 or -9 to denote unknown values. These values are changed to -1 since thse columns do not contain negative values. -1 now indicates the presence of unknowns.

5.   Some unimportant columns are dropped from the database for improving the performance of the models implemented.

6.   Now use sklearn pipes and preprocessing methods to fill in NA values for numerical features and perform one hot encoding on categorical features.

7.   This encoding will convert the categorical features into a format that will fit for the machine learning models. It will convert the categorical features into numerical features.

B. Parameter Tuning, Validation and Testing

To identify the best combination of parameters for random forest we run a grid search using different inputs. The grid search here is a randomized grid search that will pick 10 combinations of parameters randomly. This saves time and computing power.

The metric use for evaluation is the f1 weighted score. In the case of attack types, both precision and recall are equally important. The weighted f1is selected to get a weighted average of all f1 scores since the dataset is unbalanced.

1. Proposed classifier is Random Forest Classifier, in that I set class_weight to balance to weight each target class inversely to its frequency. Additionally, I set n_jobs=-1 to use all of my CPU cores. There are many potential combinations for grid search so used a RandomizedSearcbCV that will randomly select a number of combination to execute as specified by n_iter. Set CV=5 for 5-fold cross validation. The total number of fits is 50.

2.   Random Forest (RF) is an algorithm that integrates several DTs by ensemble learning. RF generally uses the mean or mode of the prediction results of each DT defined in the decision tree as the final prediction value. RF in Python scikit-learn package uses mean as predictor variable. RF is less likely to suffer from overfitting than individual DTs because each DT in the random forest cannot see the full picture of the training set. Each DT only trains part of the feature data and does not remember all the noise in the training set.
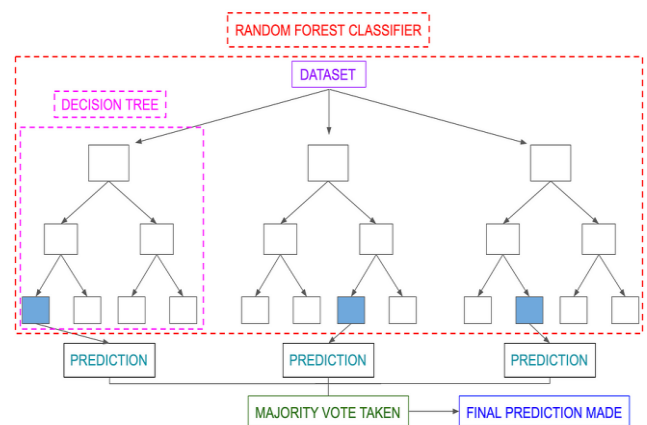

Figure 2: Working of Random Forest.

4.3 Proposed Algorithm for Global Terrorism Detection

Detecting global terrorism using machine learning algorithms like Random Forest is a complex task that involves handling a large volume of data from various sources, including social media, government reports, news articles, and more. Here's a high-level outline of an algorithm that could be used for global terrorism detection using the Random Forest algorithm:

1. Data Collection and Preprocessing:

  - Gather data from various sources, including databases of past terrorist incidents, open-source intelligence, and social media.

  - Preprocess the data by cleaning it, handling missing values, and converting it into a structured format suitable for machine learning.

  - Feature extraction: Extract relevant features such as location, date, terrorist group, attack type, casualties, and more.

2. Data Labeling:

  - Label the data instances as either "terrorist activity" or "non-terrorist activity." This labeling can be done based on historical data and expert knowledge.

3. Feature Engineering:

  - Create additional features that may aid in the detection of terrorism, such as sentiment analysis of social media posts, geopolitical factors, economic indicators, etc.

4. Data Splitting:

  - Split the dataset into training, validation, and test sets. The training set is used to train the Random Forest model, the validation set is used for hyperparameters tuning, and the test set is used for evaluation.

5. Random Forest Model:

  - Train a Random Forest classifier using the training dataset. Random Forest is an ensemble method that combines the predictions of multiple decision trees to improve accuracy and reduce overfitting.

  - Tune hyperparameters like the number of trees, tree depth, and minimum samples per leaf using the validation set to optimize performance.

6. Model Evaluation:

  - Evaluate the Random Forest model on the test dataset using appropriate metrics such as accuracy, precision, recall, F1-score, and ROC-AUC.

  - Use cross-validation techniques to ensure the model's robustness.

7. Deployment:

  - Once the model performs well, deploy it in a real-time or batch processing environment to continuously monitor and detect terrorist incidents.

8. Monitoring and Feedback Loop:

  - Continuously collect new data and feed it into the model for real-time monitoring.

  - Implement a feedback loop to retrain the model periodically with new data to adapt to evolving patterns of terrorism.

9. Model Maintenance:

  - Regularly update the model with new data and retrain it to maintain its accuracy and effectiveness.

  - Monitor the model's performance and make necessary adjustments to account for changes in the global terrorism landscape.

It's important to note that this is a simplified overview, and the actual implementation of such a system is a complex and ongoing process that requires domain expertise, data privacy considerations, and collaboration with relevant authorities and organizations. Additionally, ethical and legal considerations should be taken into account when implementing such a system for global terrorism detection.

4. Result Analysis

Table below compares the weighted average values for all the three models implemented.

Algorithms	Weighted Average F1 Score
Logistic Regression	91.81
Random Forest	92.36
Support Vector Machine	92.46

Table 1: Comparisons of Weighted AverageF1 Score Values.

The chart below represents the weighted F1 Score Comparisons of all the three models.
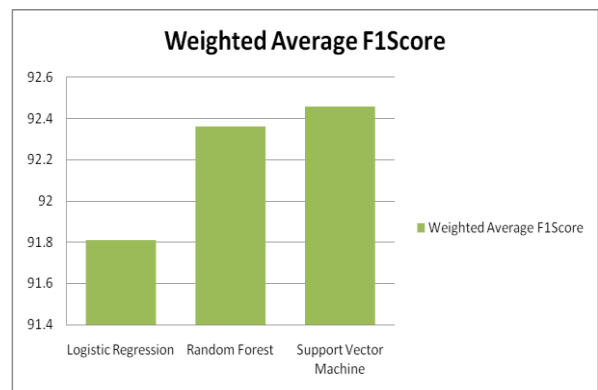

Figure 4: Comparison chart for weighted F1 Score.

Table below compares the accuracy values for all the three models implemented.

Algorithms	Accuracy (%)
Logistic Regression	92
Support Vector Machine	92
Random Forest	93

Table 6.2: Comparisons of Weighted AverageF1 Score Values.

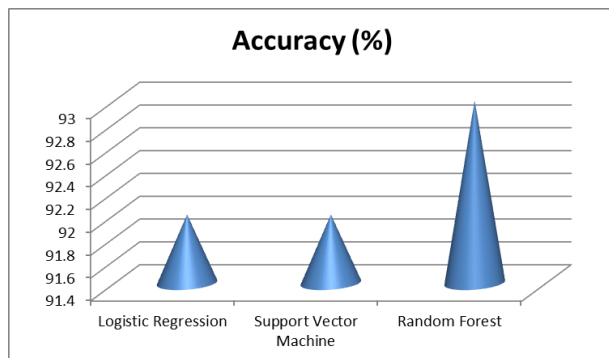The chart below represents the accuracy Comparisons of all the three models.

Figure 5: Comparison chart for accuracy.

5. Conclusion

In the era of artificial intelligence, our research focuses on the application of BN in the consequence assessment of terrorist attack. After literature review, we conclude two shortcomings in the application of BN:

(1) The strong correlation between the influencing factors violates the conditional independence assumption (CIA) in BN;

(2) How to objectively screen effective evaluation indicators from a large number of indicators.

Aiming at the above two problems, we introduce Random Forest to propose a new weighted model. From the perspective of entirety, the RF-based consequence assessment model of terrorist attack is designed, combining objective data and expert knowledge. Firstly, RF is applied to filter effective evaluation indicators objectively. Then, RB is adopted by using multiple decision trees to calculate weights of indicators and the model is built by structure learning and parameter learning. Finally, assessment experiments are conducted with terrorist attack events recorded by GTD to verify the proposed model's feasibility and performance. The experiment results show that the Random Forest model based on multiple decision trees has higher evaluation accuracy and more reliable interpretability than the traditional models.

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