A Smart Survey on Intrusion Attack Detection System

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Abstract- *Close by with computerized marks and Cryptographic conventions, Intrusion Attack Detection Systems (IADS) are decided to be the last shape of assurance to ensure a framework. In any case, the significant trouble with the present principally respected IADSs (Intrusion Attack Detection System) is the innovation of huge amount of bogus positive (FP) alarms close by with the genuine positive (TP) cautions, which is an off-kilter task for the administrator to analyze to organize the legitimate reactions. Along these lines, there is a colossal necessity to find this territory of study and to find a sensible arrangement. A fundamental impediment of Intrusion Attack Detection Systems (IADSs), in spite of their location technique, is the tremendous number of alarms they produce consistently that can easily debilitate security administrators. This limitation has control specialists in the IADS society to not just broaden better identification calculations and mark tuning strategies, however to likewise zero in on deciding an assortment of relations between singular cautions, officially known as ready connection. There are an assortment of approaches of interruption recognition, like Pattern Matching, Machine Learning, Data Mining, and Measure Based Methods. This paper points towards the legitimate review of IADS with the goal that scientists can utilize it and locate the new procedures towards interruptions.*

Keywords- Intrusion Attack Detection System, False positive alert, KDD Cup99, Anomaly detection, Mis use detection, Machine Learning.

I. INTRODUCTION

An intrusion is a sequence of related actions performed by a suspicious adversary, which result in the form of compromise of a target system. These kinds of actions actually violate a certain security policy of the system. Security policy of a system defines which actions are considered to be malicious for the system and should be prevented in order to maintain the security of the system [2]. The process of identifying and responding to suspicious activities of a target system is called Intrusion Detection. It is a complementary approach to security with respect to the mainstream approaches, such as access control and cryptography [2]. Intrusion Attack Detection Systems are used to monitor computer systems, as well as the network and to raise alarms when some intrusive activities are detected.

But most of the popular IADSs suffer from generating false alarms in a large volume. False alarms could be of two types. One is called false positive which is generated mistakenly by the IADS as an evidence of malicious behavior of the system, but in reality, it is not such a behavior. The other type of false alarms is called false negative. It is generated by the IADS as an evidence of non malicious event, but in reality, it should be an indication of malicious activity in the system [10]. Previous research on this area reports that this value could be as high as several hundred thousand a day but around 99% of them are false alarms while monitoring intrusion in an active operational network [11]. Network security officers need to investigate each IADS alarm manually whether it is a false or a true alarm. So, it is a quite time consuming, error prone and hard task for the network security officer to investigate manually and take proper action accordingly. Thus we have chosen to address the false alarm problem of IADSs in our survey.

Intrusion Attack Detection Systems is of two types based on sources of audit information [3]:

- Host based Intrusion Attack Detection System (HIADS): It refers to intrusion that take place on a single host system. This type of IADS gets it audit data from host audit trails and monitors activities such as file changes, integrity of system, system logs and host based network traffic. When any suspicious activity found by IADS, it alerts the system administrator or alert the central management server. Server or user or both can block the user request, this judgment is based on the mechanism installed in the local host system [12].
- Network based Intrusion Attack Detection System (NIADS): It is used to monitor the network traffic to protect the system from network based threats. It gets its data from monitoring the network traffic by using sensors and keeps the records in its defined format in the system log. It tries to detect malicious activity like Denial-of-Service (DoS) or Distributed Denial-of-Service (DDoS) [12].

1.1. General Architecture of Intrusion Attack Detection System:

A general Architecture of IADS is shown in figure 1. Typically, IADS uses the information available in system configuration data, audit storage and previously known attacks (reference data). The IADS can be placed in the system. It can be located in target system or external to it. In former case if target system is compromised theIADS can also be invaded, in later case it IADS can be safe. IADS may use active information that is running in the system for reducing the detection time. On detecting anomaly IADS send alarm to Site Security Officer (SSO). For detection of anomaly we set the baseline for normal behaviour in IADS. For detection of true intrusion it is crucial to set the baseline of normal behaviour in IADS, because if it not so system may generate false alarms.

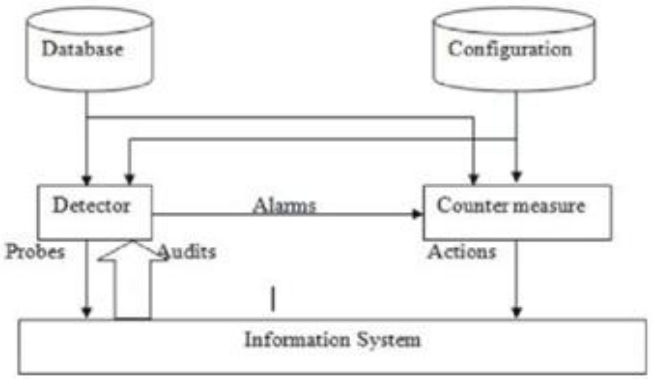

Fig. 1: General Architecture of IADS.(Ref : Google.com)

The objective of this paper is to identify the various attacks and defence system against the intrusions. We describe different techniques and approaches of intrusion detection so that researchers can do better comparative studies and find the new approaches of intrusion detection.

Rest of the paper is organized as follow: Section 2 describes traditional IADS briefly, security functions and measures of IADS. Various types of attacks to the network are described in section 3. In section 4 previous work done is analyzed, section 5 states the current problem statement of the IADS and finally in section 6 we conclude our paper.

Traditional Intrusion Attack Detection Systems

There are two types of Intrusion Attack Detection System [4].

Anomaly Detection: It refers to the technique which is used to detect the malicious activities based on deviation from normal behaviour. These activities are considered as an attack to the system. It can also detect the unknown intrusions. All that can happen because we can train this type of IADS for unknown abnormal behaviour. For training set we can use the system logs of past activities, database of normal and abnormal behaviour, and systems configuration files. The detection rate of anomaly based IADS is high but it also generate false alarms proportionally.

Three broad categories of anomaly detection techniques exist:

- Unsupervised anomaly detection: These techniques detect anomalies in an unlabeled test data set under the assumption that the majority of the instances in the data set are normal.
- Supervised anomaly detection: These techniques require a data set that has been labeled as "normal" and "abnormal" and involves training a classifier.
- Semi-supervised anomaly detection techniques construct a model representing normal behavior from a given normal training data set, and then testing the likelihood of a test instance to be generated by the learnt model.

Misuse Detection (or Signature-based Detection): Misuse detection or Signature-based detection mainly depends on identifying known signatures. It means in this system we first need to determine the normal behaviour of the user, based on that IADS can define an activity as a normal or a threat to the system. So, this IADS system is used only for detecting known attacks (intrusions). The drawback of this system is that, a slight modification in activity can lead the system to not to generate the alarm, it can or cannot be a malicious activity. The detection rate of these IADS is low but it generates very low false alarms.

IADS provide following security functions:

- **Data Confidentiality:** It checks whether data/information stored in the system is secure or vulnerable to attack. It is the required security function because sometime system uses the sensitive information.
- **Data Availability:** It checks whether the information is available to authorized user or not. Sometimes the valid user cannot access the system information because of DoS attack, so IADS should be tough against the DoS attacks. Again this is a very required security check.
- **Data Integrity:** It ensures that data is consistent and correct throughout the life cycle of an event. The data should not be changed in between of an event and also a valid/authorized user can have rights to change the data.

Primary criterions of measurements for IADS are as follows [1]:

- **Burglar Alert:** A signal is suggesting that a system has been or is being attacked [7].
- **Detection Rate:** The detection rate is defined as the no. of intrusion instances detected by the system (True Positive) divided by the total no. of intrusion instances present in the test set [8].
- **False Alarm Rate:** Defined as the number of 'normal' patterns classified as attacks (False Positive) divided by the total number of 'normal' patterns [8].

Types of Attacks

- **DoS Attack:** Denial-of-Service (DoS) or Distributed Denial-of-Service (DDoS) attack is the type of attack in which computer resources becomes unavailable to authorized users. These attacks slow down the system or deny the services of valid user. Due to this attack a lot of network traffic occurs [3].
- **Probing:** In this type of attack an attacker constantly monitors the network to find its vulnerabilities.
- **Eavesdropping Attack:** It is a network layer attack, in which an attacker captures the packets from the network that are transmitting from a host to others. Attacker can read sensitive and confidential information that is transmitting.
- **User to Root Attack (U2R):** In this attack, attacker starts his activity as a user and takes down the password, next do the dictionary attack and finally attacker gain access as a root user.
- **Remote to User Attack (R2U):** In this attack an attacker sends the packets to a machine over the network but does not have an account on local machine, by using the vulnerabilities of the system attacker gain local access to the system as a user.
- **Man-in-the-Middle Attack:** In this type of attack the attacker situated himself in the middle of two persons in communication, and both persons in communication think that they both communicating to each other but all the conversation is compromised.
- **Smurf Attack:** A smurf attack is an exploitation of the Internet Protocol (IP) broadcast addressing to create a denial of service. The attacker uses a program called Smurf to cause the attacked part of a network to become inoperable [9].

II. RELATED WORK

In related work we explore previous work carried out by various researchers in the field of attack classification of KDD cup dataset in recent years. This section presents brief descriptions of the Data Mining and Machine Leaning approaches used by various researchers

Asak et al. [13] proposed a method for discriminate analysis of Machine learning based Intrusion Detection. In which a feature selection based method is utilized for the classification of individual attack. Author's utilizes system log information as experimental purpose.

Ramani et. al. [14] proposed a Discriminate Analysis based Feature Selection of KDD Intrusion Dataset. In this paper [14], important features of KDD Cup 99 attack dataset are extracted by the use of discriminate analysis method. Author's mentioned that proposed method is suffering by two-class classification or multiclass classification problems.

Kayacik et. al. [15] proposed a work of feature relevance analysis on KDD'99 dataset on the basis of information gain. Feature relevance is expressed in terms of information gain, which gets higher as the feature gets more discriminative. On the basis of result authors sagest that normal, neptune and smurf classes are highly related to certain features that make their classification easier. On the other hand authors told about certain features have no contribution to intrusion detection.

Balakrishnan et. Al[16] proposed a new feature selection algorithm based on InformationGain Ratio. The feature selection decreases the classification time. The author claims that proposed IADS reduce the false positive rates and classification time.

Adetunmbi A.Olusola et. Al [17] proposed the relevance of each feature in KDD '99 intrusion detection dataset to the detection of each class. Rough set degree of dependency and dependency ratio of each class were employed to determine the most discriminating features for each class. Empirical results show that seven features were not relevant in the detection of any class.In this paper, selection of relevance features is carried out on KDD '99 intrusion detection evaluation dataset.

Empirical results revealed that some features have no relevance in intrusion detection.

N.S.Chandolikar et. Al [18] in this paper authors evaluate performance to two well known classifiers Bayes Net and J48 algorithms for attack classification. The key ideas are to use data mining techniques efficiently for intrusion attack classification. J48 learning algorithm was found to be performing better than Bayes Net in terms of better accuracy and lower error rate. Experiment performed on KDD cup dataset demonstrates that J48 algorithm is an

efficient algorithm for classification. Accuracy demonstrated helps to improve efficiency of Intrusion Attack Detection System.

Prof. N.S. Chandolikar et. Al [19] in this paper authors present the work on, KDD '99 intrusion detection dataset, which is evaluated to find out most important and relevant features. Proposed work based on selection of appropriate feature for reducing the analysis effort and time. Authors suggest that feature identification helps to improve efficiency of Intrusion Attack Detection System.

Megha Aggarwal and Amrita [20] present the work on; a comparative analysis which is based on the basis of detection rate, computational time and root mean square error. In this work authors used six feature selection algorithms and their performance is evaluated using Naïve Bayes and C4.5 (J48) classifier. The authors has been observed that Naïve Bayes takes less time to test the dataset but more time in training the set whereas C4.5 does the reverse.

Himadri Chauhan et. Al [21] in this paper, authors presents the comparison of different classification techniques to detect and classify intrusions into normal and abnormal behaviours. J48, Naive Bayes, JRip, and OneR algorithms are used by authors. Authors use the WEKA tool to evaluate these algorithms. The experiments and assessments of these methods are performed with NSL-KDD intrusion detection dataset. The main task of this paper to show the comparison of the different classification algorithms and find out which algorithm will be most suitable for the intrusion detection.

S. Ranjitha Kumari and Dr. P. Krishna kumari [22] in this paper authors have done a survey on four supervised machine learning algorithms: Decision Tree (J48), K-Nearest Neighbour (KNN), Naïve Bayes (NB) and Support Vector Machine (SVM). Authors have shown a comparative analysis of these algorithms based on Accuracy, True Positive Rate (TPR) and False Positive Rate (FPR). Authors have used NSL-KDD dataset for our experiment. On the basis of experimental result, Authors have shown that the performance of Decision Tree (J48) and K-Nearest Neighbor are better than other two algorithms in terms of Accuracy, True Positive Rate (TPR) and False Positive Rat (FPR).

III. COMPARATIVE ANALYSIS OF EXISTING METHODS

Title of the paper	Enhanced Intrusion detection system via agent clustering and classification based n outlier detection	A deep learning approach for effective intrusion detection in wireless networks using CNN.	A stacking Ensemble for Network Intrusion Detection using Heterogeneous Datasets	Machine Learning based intrusion detection system	TIDCS: A dynamic Intrusion Detection and classification System based Feature Selection
Method/ Algorithm/ Technique	Kmeans clustering	Support vector machines KNN, Bayesian and Decision tree	LR(Logistic Regression) KNN, Random Forest(RF)	SVM,Naive Bayes	Naive Bayes, SVM, K- NN, RF
Dataset	Datasets: KDD cup 99 Result: accuracy with 92.23%	Datasets: KDD 9 cup dataset Ilseda, NSS KDD	Dataset: NSS KDD, UGR 16, UNSWNB-15	Datasets: KDD cup 1999 Result: accuracy up to 95.75%	Dataset: UNSW NB-15 Result: accuracy with different datasets like UNSW NB-15 is 91% , online AODE is 93.47%,80% for EDM
Proposed Solution	In this paper at first pre-processing is performed to remove unwanted spaces using outlier detection, KNN is used for categorization of attacks.	This paper uses CNN for detecting the known and unknown attacks effectively.	There is challenge to improve detection rate of different attacks used in this research	In proposed system each phase is essential To examine function of SVM and Naïve Bayes classifiers are essential steps.	This paper makes proposed system combines machine learning techniques and the results shows the good performance.

IV. PROBLEM STATEMENT

The effectiveness of IADS depends on the capability to detect any abnormal activity in the target system, which is called the sensitivity of IADS. If the IADS are more sensitive, the security of the system would be tighter. To making the IADS more sensitive means to apply tighter signature rules or to be less tolerant to anomalies. As a result, the IADS become more sensitive to its input and generate a lot of alarms each day, even though most of the examined events are not illegal events.

Due to large volumes of IADS false alarms, it is a quite tough task for the security officers to investigate manually which are the real suspicious alarms and thereafter take proper action against them. Even sometimes, some real suspicious alarms are ignored mistakenly by the security officer due to large volumes of false alarms and thereby mistakenly interpret a real alarm to be a false alarm. This is the most dangerous situation when a real instance of an attack is ignored by the security officer and thus the IADS become useless though its functionality remains the same. We have chosen to investigate about this problem in our research and thus our research problem is whether we can reduce the IADS false alarm problem to a reasonable amount, or not.

V. CONCLUSION

Extensive research is going on in the field of Computer intrusion detection and several IADSs are already developed. But their performance is poor by producing false positives at higher rate. Researchers proposed several intrusion detection approaches and each detection approach is suitable only for detecting a particular type of attack(s). Because of limited attack coverage of each approach, there is

an urgent need to arrive of a generic detection approach that handles almost all types of attacks. For that it is required to understand and analyze the techniques that are already investigated by several researchers. Keeping that in view here, we have made an attempt to review the well known intrusion detection approaches. Comparison of various approaches is made to show the strength and weakness of these approaches. We hope this study will be useful for researchers to carry forward research on system security for designs of IADS that not only will have identified strengths but also overcome the drawbacks.

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