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Database Security Using Intrusion Detection System

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Abstract: We propose a project named "Database Security Using IDS".SQL injection attack is the most common attack in websites now-a-days. SQL Injection refers to an injection attack wherein an attacker can execute malicious SQL statements that control a web application's database server. In this project we propose database intrusion detection mechanism to enhance the security of database through a Website. We will make a system which will log all the activities of an Intruder using SQL Injection in a website. Some malicious codes gets injected to the database by unauthorized users and because of this attack, the actual database can be stolen or destroyed or modified by the hacker. Administrator will be shown the details of the user and can block him if needed. User details are secured using AES encryption algorithm which makes this system more secure.

Keywords: SQL injection, AES symmetric key algorithm, Intrusion Detection System, Database Malicious Transaction Detector, Log-based approach

1. INTRODUCTION

Intrusion detection system detects the malicious activity in the database and notifies the administrator of the system accordingly. To secure data and detect malicious activities in database, intrusion detection system is integrated with the shopping site and detects malicious activities in site's database. Intrusion Detection System is a system in which malicious activity performed by any user or program is logged and can be viewed later by the admin. Anyone who gets access to the database login/password used by the application has the ability to frequently read or modify the database, bypassing all the security features built into the application. Therefore, security measures have been taken to ensure security at the application logic level, we need to have the ability to detect any malicious actions into the database. I As a part of the project, a website will be developed where users can buy shopping products. Different users- Administrator and customer will have different access rights to the system. This project is a base project for developing a Intrusion Detection System related subsystem which can be used in any other application.

1.1. Objectives

Building a system which can log of all the activities in a database. Currently this is integrated with a shopping website and will be able to track activities like selection of categories of product, adding product to the cart, buying products etc. The main objective of this project is to secure the database using Intrusion Detection System. Sql injection attack is very common attack to hack details of the user's transaction details present in the shopping site. Sql injection is a technique to insert sql queries in the database to steal the data from database. So as to secure database from this attack the parameterized queries developed by the user from this an attacker is not able to change the intent of a query, even if SQL commands are inserted by an attacker. In the safe example below, if an attacker were to enter the userID of tom' or '1'='1, the parameterized query would not be vulnerable and would instead look for a username which literally matched the entire string tom' or '1'='1. The objective of this project is to develop a secure path for transaction done by the user. Using AES (Advanced Encryption Standard) encryption technique, the transaction and user account details can be made secured.

2. LITERATURE REVIEW

Intrusion is any set of actions that attempt to compromise the confidentiality, availability or integrity of a resource. Intrusion Detection Systems determines the illegal actions performed against computer systems and alerting the system administrator.

Detection of Malicious Transactions in DBMS

Marco Vieira ,Henrique Madeira are the authors of this paper. Malicious database transactions are related to security attacks carried out either externally or internally to the organization. External security attacks are intentional unauthorized attempts to access or destroy the organization's private data. On the other hand

internal security attacks are intentional malicious actions executed by authorized users. This paper proposes a new mechanism for the detection of malicious transactions in DBMS, the Database Malicious Transactions Detector (DBMTD) mechanism. Using the DBMTD mechanism consists of two different phases: transaction profiling and intrusion detection. Transaction profiling consists in representing the authorized transactions as sequences of valid commands.. The nodes in the graph represent commands and the arcs represent the valid execution sequences. Intrusion detection consists in the detection of users executing sequences of commands that potentially represent intrusion attempts. To detect malicious transactions the sequence of commands executed by each user is compared with the profile of the authorized transactions.

Analysis of SQL Injection Attacks and Prevention Methods in Web Applications

Dr. Amit Chaturvedi, Aijaz Ahmad Rather are the authors of this paper. SQL injection (SQLi) refers to an injection attack wherein an attacker can execute malicious SQL statements (also commonly referred to as a malicious payload) that control a web application's database server (also commonly referred to as a Relational Database Management System – RDBMS). Since an SQL injection vulnerability could possibly affect any website or web application that makes use of an SQL-based database, the vulnerability is one of the oldest, most prevalent and most dangerous of web application vulnerabilities. By leveraging SQL injection vulnerability, given the right circumstances, an attacker can use it to bypass a web application's authentication and authorization mechanism and retrieve the contents of an entire database. SQL injection can also be used to add, modify and delete records in a database, affecting data integrity.

Implementation of Advanced Encryption Standard Algorithm

Cryptography plays an important role in the security of data transmission. It is the study of mathematical techniques related to aspects of information security such as confidentiality, data integrity, entity authentication and data origin authentication.This paper addresses efficient hardware implementation of the AES (Advanced Encryption Standard) algorithm and describes the design and performance testing of Rijndael algorithm. The algorithm is composed of three main parts: cipher, inverse cipher and Key Expansion. Cipher converts data to an unintelligible form called plaintext. Key Expansion generates a Key schedule that is used in cipher and inverse cipher procedure. Cipher and inverse cipher are composed of special number of rounds. For the AES algorithm, the number of rounds to be performed during the execution of the algorithm uses a round function that is composed of four different byte-oriented transformations: Sub Bytes, Shift Rows, Mix columns and Add Round Key.A strong focus is placed on high throughput implementations, which are required to support security for current and future high bandwidth applications.

3. PROBLEM STATEMENT

A website needs to be developed that will allow users to buy products. A registered user can buy the product by providing his/her login details after which payment details are submitted. The system should be secure and should not allow a user to perform tasks that he is not authorized to do. All the activities on the website should be logged into an Intrusion Detection System to identify if any malicious activity is being performed on the system. A user with admin rights can view these logs. In this system, logs consisting transaction sequence helps Intrusion detection , to detect the malicious transactions. Transaction profiling corresponds to the identification of the sequence of commands that constitute each valid transaction. The administrator can view the database at any time. He can send the data to analyze the database for automatic analysis that will give results in the form of all unauthorized requests sent by a user. The intrusion detection system detects the malicious tasks happens in the system and report of that malicious activities to the administrator and administrator takes the appropriate action. Basically, this system perform following steps, All the transactions (activities) performed on the website should be logged into database system to identify if any malicious activity is performed on the system. This system will be able to track the transactions performed by the users – authorized and unauthorized. The administrator and higher authorities only can view these logs and perform profiling wherein they identify different transactions that are possible in the system.

4. EXISTING SYSTEM

In existing system, the software based site is used to buy products, the customer checks the products and then add to the cart and proceed to the payment/transaction. The customer selects the product according to their requirements and add to the cart, the quantity of the product is choose by the customer and total amount is displayed in transaction page. The customer can make payment using a credit card. The customer fills all transaction details required to perform the transaction but it will not be secure. Any attacker can inject a sql command in database and can see the details of the customer. The existing system do not support the intrusion

detection system that did not gave the information about any malicious activity done in database to the administrator.

4.1. Limitations

In existing system, customer does manual shopping but while online payment using card, the card details are stored as it is into the database without any encryption. There is a possibility of card details getting hacked.It is not secure to do transaction online The attacker can anytime check the customer details using any type of attack like SQL injection. Because of this attack the software based site or shopping site will be hacked and all necessary details and coding, programs are seen by the attacker and can perform any malicious activity within the database.

5. PROPOSED SYSTEM

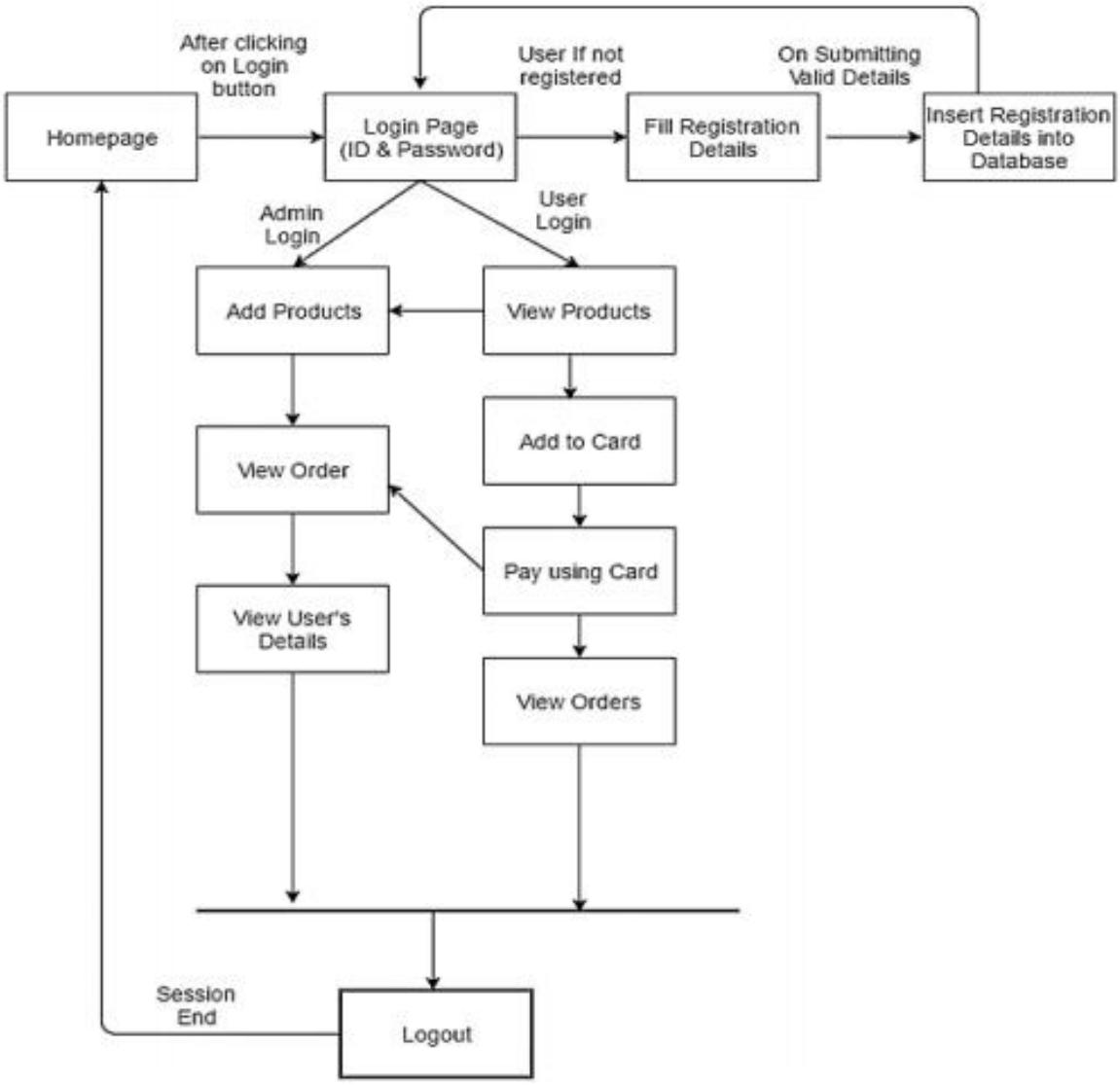


Fig.5 Proposed System

Considering the major anomalies into the existing system, we conclude to build this proposed system. The highlighted part here is encryption of card data using AES (Advanced Encryption Standard) technique. The Online Shop secures the card payment and won't let the card data to get hacked. While user doing a card payment, all the card data is encrypted and then stored into database. System also keeps user details in an encryption form using AES encryption. The system is built of handling SQL Injection capabilities which doubles the security of database and prevents from injection hacking codes into the database. In the proposed website there are different parts or modules which are summarized as follows:

CUSTOMER REGISTRATION: Customers are required to register on the website be - fore they can do the shopping. The website also provides several features for the non-registered user. Here they can choose their id and all the details regarding them are collected and a mail is sent to the email address for confirmation.
SHOPPING CART: Shopping cart module tries to simulate the working of a store where user can view each Product type, size and price of the product available. The items they like can be added to the logical cart and can be removed if not required later. Billing and other payment related matters are handled here.
ADMINISTRATION: This is the part of the website where the administrators can add delete or update the product information. Administrators are also responsible for adding and deleting the customers from the website. In addition, newsletter and promotions are also handled by the site administrator via email.
SEARCH: This facility is provided to both registered and unregistered user. User can search for the availability and type of products available on the website.
ADD TO CART: Users can add Product to cart.
CREDIT CARD PAYMENT: After total bill is calculated user can pay via credit card online with homomorphic encryption technique.

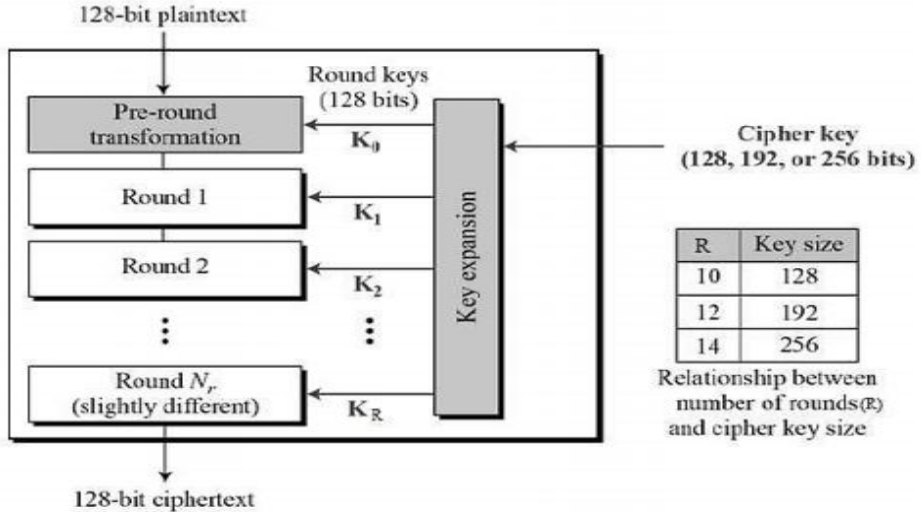
6. IMPLEMENTATION DETAILS

The whole implementation is done using windows operating system. The design and coding is done using PHP, WAMP Server & Notepad++. Database is created and maintained using MySQL.

6.1. AES Algorithm

AES is based on a design principle known as a substitution-permutation network, a combination of both substitution and permutation, and is fast in both software and hardware. AES is a variant of Rijndael which has a fixed block size of 128 bits, and a key size of 128, 192, or 256 bits.It is found at least six time faster than triple DES. The features of AES are as follows − Symmetric key symmetric block cipher 128-bit data, 128/192/256-bit keys Stronger and faster than Triple-DES Provide full specification and design details Software implementable in C and Java

Operation of AES: AES is an iterative rather than Feistel cipher. It comprises of a series of linked operations, some of which involve replacing inputs by specific outputs (substitutions) and others involve shuffling bits around (permutations). Interestingly, AES performs all its computations on bytes rather than bits. Hence, AES treats the 128 bits of a plaintext block as 16 bytes. These 16 bytes are arranged in four columns and four rows for processing as a matrix − Unlike DES, the number of rounds in AES is variable and depends on the length of the key. AES uses 10 rounds for 128-bit keys, 12 rounds for 192-bit keys and 14 rounds for 256-bit keys. Each of these rounds uses a different 128-bit round key, which is calculated from the original AES key. The schematic of AES structure is given in the following illustration –



R	Key size
10	128
12	192
14	256

Relationship between number of rounds(R) and cipher key size

Fig. 6.1(a) AES Structure

Encryption
Here, we restrict to description of a typical round of AES encryption. Each round comprise of four sub-processes. The first round process is depicted below –

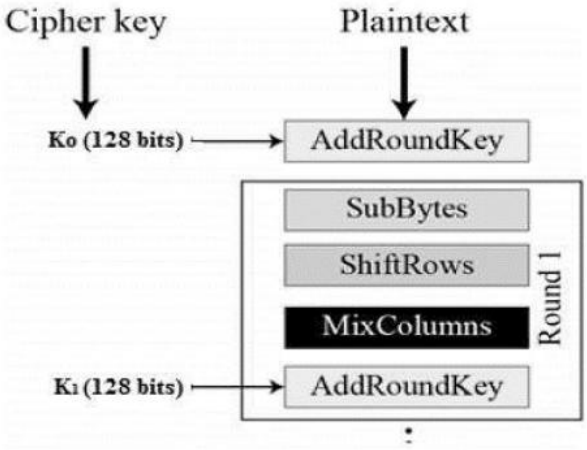


Fig. 6.1(b) Encryption First Round Process

Byte Substitution (Sub Bytes)

The 16 input bytes are substituted by looking up a fixed table (S-box) given in design. The result is in a matrix of four rows and four columns.

Shift rows

Each of the four rows of the matrix is shifted to the left. Any entries that 'fall off' are re-inserted on the right side of row. Shift is carried out as follows − First row is not shifted. Second row is shifted one (byte) position to the left. Third row is shifted two positions to the left. Fourth row is shifted three positions to the left. The result is a new matrix consisting of the same 16 bytes but shifted with respect to each other.

Mix Columns

Each column of four bytes is now transformed using a special mathematical function. This function takes as input the four bytes of one column and outputs four completely new bytes, which replace the original column. The result is another new matrix consisting of 16 new bytes. It should be noted that this step is not performed in the last round.

Add round key

The 16 bytes of the matrix are now considered as 128 bits and are XORed to the 128 bits of the round key. If this is the last round, then the output is the cipher text. Otherwise, the resulting 128 bits are interpreted as 16 bytes and we begin another similar round.

Decryption

The process of decryption of an AES ciphertext is similar to the encryption process in the reverse order. Each round consists of the four processes conducted in the reverse order − Add round key Mix columns Shift rows Byte substitution Since sub-processes in each round are in reverse manner, unlike for a Feistel Cipher, the encryption and decryption algorithms needs to be separately implemented, although they are very closely related.

6.2 SQL Injection

SQL Injection Attacks have emerged as one of the most serious threats to the security of database-driven applications. They are very common due to two factors: the significant prevalence of SQL Injection vulnerabilities, and the attractiveness of the target (i.e., the database typically contains all the interesting/critical data for your application). SQL injection attacks are initiated by manipulating the data input on a Web form such that fragments of SQL instructions are passed to the Web application. The Web application then combines these rogue SQL fragments with the proper SQL dynamically generated by the application, thus creating valid SQL requests. These new, unanticipated requests cause the database to perform the task the attacker intends. To clarify, consider the following simple example. Assume we have an application whose Web page contains a simple form with input fields for username and password. With these credentials the user can get a list of all credit card accounts they hold with a bank. Further assume that the bank's application was built with no consideration of SQL injection attacks. As such, it is reasonable to assume the application merely takes the input the user types and places it directly into an SQL query constructed to retrieve that user's information. In PHP that query string would look something like this: $query = "select accountName, accountNumber from creditCardAccounts where username='".$_POST["username"]."' and password='".$_POST["password"]." ' " Normally this would work properly as a user entered their credentials, say johnSmith and myPassword, and formed the query: $query = "select accountName, accountNumber from creditCardAccounts where

username='johnSmith' and password='myPassword' This query would return one or more accounts linked to Mr. Smith. Now consider someone with a devious intent. This person decides they want to see if they can access the account information of one or more of the bank's customers. To accomplish this they enter the following credential into the form: ' or 1=1 -- and anyThingsAtAll When this SQL fragment is inserted into the SQL query by the application it becomes: $query = "select accountName, accountNumber from creditCardAccounts where username='' or 1=1 -- and password = anyThingsAtAll The injection of the term, ' or 1=1 --, accomplishes two things. First, it causes the first term in the SQL statement to be true for all rows of the query; second, the -- causes the rest of the statement to be treated as a comment and, therefore, ignored during run time. The result is that all the credit cards in the database, up to the limit the Web page will list, are returned and the attacker has stolen the valuable information they were seeking.

7. CONCLUSION

In the project "Database Security using IDS" we have proposed AES encryption approach to prevent the intrusion in database of the online shopping website. Also detects and prevents the intrusion attacks like SQL injection. It provides an additional layer of security in database management system (DBMS).It can be considered as generic approach for any database and overcomes the limitations of the existing database security mechanisms.

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