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## Banarsidas Chandiwala Institute of Information Technology

Affiliated to GGSIP University,  
Kalkaji, New Delhi.

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## From the Director's Desk



I welcome you all to this new edition of BCIIIT Magazine. In the information age, science and technology are the corner stone's on which the structure of society rests. The rapid advances in Information and Communication Technologies (ICT) has made the world increasingly hyper- connected and competitive, offering new challenges and opportunities, thus bringing fundamental transformation in society.

The Banarsidas Chandiwala Institute of Information Technology (BCIIT) has taken this unique initiative to encourage the innovative thoughts of its faculty and students to be put in the form of articles in e-magazine. These articles are put on the Institute website so as to be available to more people for their references, use and comments. This e-magazine is a regular annual feature of the Institute since the first issue in 2011. Some of the faculties and students who ultimately wish to pursue the Ph. D program get lot of inspiration and initiate their research in the area of interest.

One of our dreams is to see that BCIIIT stands tall among the other institutes of GGSIP University making an impact with value added contributions in the form of high standard and quality articles through its online endeavor. At our end, we feel that we have highly experienced and inspired faculty and excellent and academically brilliant students who can contribute a lot in this manner.

I hope our humble effort will go a long way in putting the resourceful thoughts of our faculty and students in improving the quality of education through technology. It is the genuine and sincere attempt of our faculty and students who are constantly putting their heart and soul to achieve the results.

I pray and wish them good luck in their endeavor.

**Dr. Ravish Saggar**  
**Director, BCIIIT**

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## Non-libc X86/64 disassembler using mnemonic instruction set

Piyush Parashar, Dr. Sushma Bahuguna

Banarsidas Chandiwala Institute of Information Technology, Delhi, India

[piyushparashar2k@gmail.com](mailto:piyushparashar2k@gmail.com), [sushma@bciit.ac.in](mailto:sushma@bciit.ac.in)

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**Abstract:** *A non-libc x86/64 disassembler that uses the memory instruction set is a disassembler specifically designed for x86/64 processors to break down machine code into symbolic instructions. is implemented in the language, and is used to assemble assembly language instructions into a human using a set of memory instructions. - readable format. This type of parser comes in handy When simple and efficient parsing is needed but it is not possible or desirable, to use a C library. The Proposed method demonstrates both accuracy and efficiency.*

**Keywords:** *disassembler; x86/64; mnemonic; non-libc; symbolic; disassembly;*

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### I. Introduction

The x86-64 Instruction Set Architecture (ISA) for computer processors is a 64-bit instruction set architecture (ISA). A disassembler is a programme that converts machine code, which is a series of simple numerical instructions that can be executed by a computer, into symbolic instruction language, which is a human-readable representation of instructions. An x86-64 Disassembler is a compiler that is specifically designed to decompile machine code for x86-64 processors. A free libc compiler does not use the C standard library, which is a collection of common libraries found in C and C++ compilers. Non-LibC tools, on the other hand, are entirely written in a scripting language, making them simpler and more efficient than the C library disassembler.

This paper puts it to the test by providing binary machine code as input and ensuring that the disassembler correctly splits the code into assembler-equivalent instructions. Which may necessitate iterating on implementation and making necessary adjustments to improve performance and accuracy. The purpose of this paper is to propose the development of a disassembler library for the x86 and x86-64 processors. It is written in C and is designed to be fast, portable, and easy to use

### II. non-libc x86-64 disassembler - Mnemonic Instruction Set

Mnemonics refers to the method by which instructions are written in the symbolic instruction language. Each statement in a set of mnemonics is represented by a short, easy-to-remember word or abbreviation, such as "mov" for "move" and "jmp" for "jump". Assembly language programmes are easier to read and write than a set of numeric instructions, where each instruction is represented by a numeric opcode.

In summary, the non-libc x86-64 disassembler using instruction set mnemonics is a disassembler designed specifically to disassemble machine code for x86-64 processors, implemented in a symbolic instruction language, and represented by voice prompts. This type of disassembler is useful when a lightweight and efficient disassembler is required but using a C library is not possible or desirable. Creating a non-libc-x86 disassembler with instruction set mnemonics necessitates some architecture-specific steps.

The next step is to select a mnemonic instruction set to represent the instructions in the disassembler. Intel syntax and AT&T syntax are two of the numerous x86 mnemonic instruction sets. Each option has advantages and disadvantages, so the user should carefully

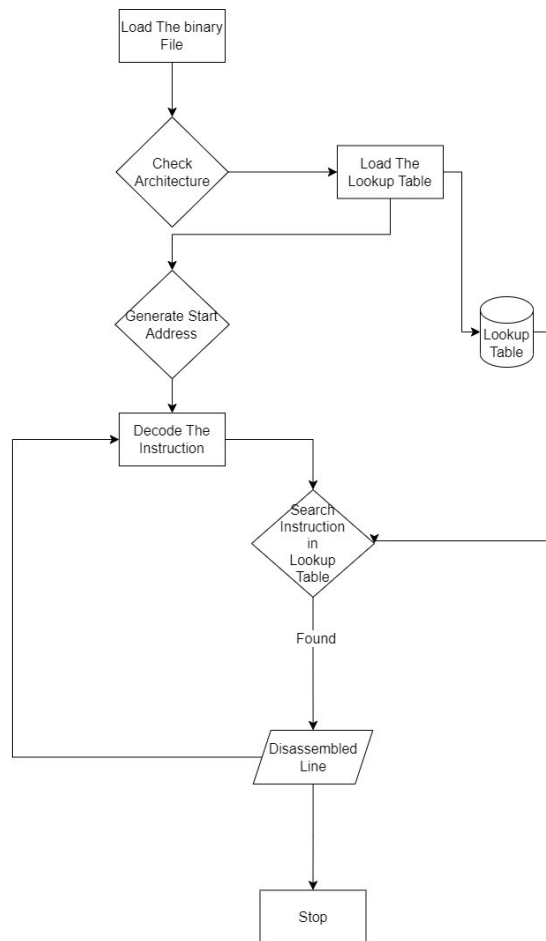


consider which one best meets their needs. Following my decision to use the mnemonic instruction set, a disassembler algorithm that could translate a stream of binary machine code into a series of instructions in a symbolic instruction language had to be implemented. After decoding opcodes to identify the instruction being performed and scanning the machine code byte by byte, instruction set mnemonics are used to express the instruction in a human-readable format.

The disassembler algorithm requires code written in the Symbolic Statement Language. This is because the disassembler will not use the C library without libc. B. Reading and comparing values from memory. Although writing code in a symbolic statement language can be difficult, it provides greater control and efficiency than a high-level programming language such as C or C++.

This disassembler converts a stream of binary machine code into a series of assembler instructions that humans can read and understand. To disassemble machine code, disassembler employs a two-step decoding procedure. In the first stage, the disassembler decodes the instruction opcode to determine the type of instruction being executed. This entails looking up opcodes in a table and using them to identify instructions and their operands.

Figure 1 Flow graph of Non-libc X86/64 disassembler using mnemonic instruction set





### III. Output

In order to decode the passed data, we used Intel x86/64 decoder. The passed data is processed in order to be processed byte by byte, and then we use mnemonic detection engine to generate the assembly line along the the execution addresses which determine the address for the instructions. Output can be received by providing a simple binary from binary. The hex code is extracted and passed as an output to the method that determines type and encoding of the binary file.

Using distinct mnemonic instruction sets, the generated instruction set is printed out since each instruction is made up of an operation and the register on which the operation is to be applied. We can utilise the operation code to find the most likely assembly code. The next step for our mnemonic instruction set decoder is to decide whether to use an AMD, Intel, or AT&T set of ISA structures. To do this, we use the system detection to determine whether we are on an Intel or AMD machine so that we can pass correct disassembly that can be debugged using the debugger.

To select the proper instruction set for each operation code that shapes our output disassembly, instructions sets are built using data from a lookup table. It is crucial to remember that the degree to which we are able to identify the type of binary and other relevant metadata, such as the platform executable it is, will determine how accurate and correct this disassembly is. Linux's use file command makes it simple to find out by printing the binary's metadata, but since we are constructing a library with no third-party dependencies, we would be concentrating on developing a module that would fetch the metadata for us in order to discover what instruction set is to be used. To do that we would use the “magic number” approach to determine as to the type of file it is which would in return would give us the required information about our file and as to what Instruction set table to be loaded with operation code in to the lookup table.

Figure 2 Output of Non-libc X86/64 disassembler using mnemonic instruction set

```
PS C:\Users\pi\Documents\testdisassembler\deps\pidis\build>
PS C:\Users\pi\Documents\testdisassembler\deps\pidis\build> .\Disassemble.exe
007FFFFFFF400000  push rcx
007FFFFFFF400001  lea eax, [rbp-0x01]
007FFFFFFF400004  push rax
007FFFFFFF400005  push [rbp+0x0C]
007FFFFFFF400008  push [rbp+0x08]
007FFFFFFF40000B  call [0x008000007588A5B1]
007FFFFFFF400011  test eax, eax
007FFFFFFF400013  js 0x007FFFFFFF42DB15
PS C:\Users\pi\Documents\testdisassembler\deps\pidis\build> █
```





## IV. Test Results

In order to check the correctness of our library's disassembly, the next test is to see if our library can decode a variety of encodings and formatting, along with the time required. This paper proposes a significant improvement over the current system, and the test results corroborate this. For our test, we used fuzzing to generate a variety of test cases, and we ran the test cases using Python.

Figure 3 Test Result of Non-libc X86/64 disassembler using mnemonic instruction set

```

Testing DEFAULT ...
Minimal-Mode 1, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 2887.93 msec
Minimal-Mode 0, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 4898.88 msec
Minimal-Mode 0, Format 1, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 7218.95 msec
Minimal-Mode 0, Format 1, Tokenize 1, Caching 0, Instructions: 10.00M, Time: 7782.16 msec

Testing 3DNOW ...
Minimal-Mode 1, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 3893.66 msec
Minimal-Mode 0, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 5661.86 msec
Minimal-Mode 0, Format 1, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 8588.66 msec
Minimal-Mode 0, Format 1, Tokenize 1, Caching 0, Instructions: 10.00M, Time: 9145.81 msec

Testing XOP ...
Minimal-Mode 1, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 4383.57 msec
Minimal-Mode 0, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 16240.17 msec
Minimal-Mode 0, Format 1, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 22945.98 msec
Minimal-Mode 0, Format 1, Tokenize 1, Caching 0, Instructions: 10.00M, Time: 34842.57 msec

Testing VEX_C4 ...
Minimal-Mode 1, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 11129.81 msec
Minimal-Mode 0, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 17851.24 msec
Minimal-Mode 0, Format 1, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 27532.67 msec
Minimal-Mode 0, Format 1, Tokenize 1, Caching 0, Instructions: 10.00M, Time: 34249.64 msec

Testing VEX_C5 ...
Minimal-Mode 1, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 18767.54 msec
Minimal-Mode 0, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 18656.60 msec
Minimal-Mode 0, Format 1, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 28538.38 msec
Minimal-Mode 0, Format 1, Tokenize 1, Caching 0, Instructions: 10.00M, Time: 30875.93 msec

Testing EVEX ...
Minimal-Mode 1, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 13066.36 msec
Minimal-Mode 0, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 22453.44 msec
Minimal-Mode 0, Format 1, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 38530.30 msec
Minimal-Mode 0, Format 1, Tokenize 1, Caching 0, Instructions: 10.00M, Time: 38670.38 msec

Testing MVEX ...
Minimal-Mode 1, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 10493.41 msec
Minimal-Mode 0, Format 0, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 18845.89 msec
Minimal-Mode 0, Format 1, Tokenize 0, Caching 0, Instructions: 10.00M, Time: 31294.23 msec
Minimal-Mode 0, Format 1, Tokenize 1, Caching 0, Instructions: 10.00M, Time: 35972.24 msec

\cases\vec5_007.in
\cases\vec5_008.in
\cases\vec5_009.in
\cases\vec5_010.in
\cases\vec5_011.in
\cases\vec5_012.in
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\cases\xop_022.in
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ALL TESTS PASSED.

```

## V. Conclusion

All things considered, this non-libc disassembler has proven to be a useful tool for deciphering code and swiftly spotting security vulnerabilities. Reverse engineering has become faster and more accurate, enabling users to fortify their programmes and safeguard their data. This disassembler has been able to offer a thorough and in-depth examination of built binaries by utilizing cutting-edge algorithms and adaptable user-defined rule-sets. It has aided in reducing the amount of time spent troubleshooting problems and increasing the efficiency of code reviews.

Users may now better understand their programme and any possible dangers by using the non-libc disassembler, which has been able to offer a higher degree of insight into the code. It has the capacity to establish custom rule-sets, which has made it possible to deliver a thorough and unique analysis. It has been able to show the inner workings of code. Additionally, the disassembler has made it possible for users to rapidly find security holes and susceptible code, helping them to secure their systems.

The way code is understood and studied has been improved by this non-libc disassembler, to sum up. Reverse engineering has become faster, more accurate, and more efficient, which has increased code security and cut down on debugging time. This disassembler has been





able to offer a more thorough and precise analysis of code due to its ability to tweak the disassembly procedure and establish unique rule-sets. This has helped users secure their systems and data by enabling them to swiftly discover and resolve security vulnerabilities.

## VI. References

- [1]. *x86 Disassembly/Disassemblers and Decompilers - Wikibooks, open books for an open world.* (n.d.). [https://en.wikibooks.org/wiki/X86\\_Disassembly/Disassemblers\\_and\\_Decompilers](https://en.wikibooks.org/wiki/X86_Disassembly/Disassemblers_and_Decompilers)
- [2]. *Solaris 2.5 Product Library Documentation.* (n.d.). Solaris 2.5 Product Library Documentation. <https://docs.oracle.com/cd/E19641-01/802-1948/>
- [3]. *Intel® 64 and IA-32 Architectures Software Developer Manuals.* (n.d.). Intel. <https://www.intel.com/content/www/us/en/developer/articles/technical/intel-sdm.html>
- [4]. Rigger, M., Marr, S., Kell, S., Leopoldseder, D., & Mössenböck, H. (2018, March 25). An Analysis of x86-64 Inline Assembly in C Programs. *Proceedings of the 14th ACM SIGPLAN/SIGOPS International Conference on Virtual Execution Environments.* <https://doi.org/10.1145/3186411.3186418>



## Test Case Prioritization and Its Significance in Software Development

Akshit Thakur

Banarsidas Chandiwala Institute of Information Technology, Delhi, India

[akshit@bciit.ac.in](mailto:akshit@bciit.ac.in)

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**Abstract:** *The test case prioritization is the technique of Regression testing in which test cases are prioritized according to the changes which are done in the project. This work is based on manual slicing and automated slicing for test case prioritization to detect maximum number of faults from the project in which some changes are done for the new version release. The slicing is the technique which will divide the whole project function wise and detect associated functions. To increase the fault detection rate the automated technique is being applied in which multi-objective algorithm is been applied which calculates the function importance in the automated manner. In the simulation it is being analyzed that fault detection rate is increased and execution time is reduced with the implementation of automated test case prioritization as compared to manual test case prioritization in regression testing.*

**Keywords:** *Regression testing, Function Importance, Fault rate, Test case prioritization*

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### I. Introduction

A set of instructions that are executed to accomplish a specific task is known as program. The execution of a series of such sets of instructions is known as software. System software and application software are the two broader categorizations of types of software available. Any type of program through which data can be processed for the user is known as application software.

Only once the software has gone through the development, testing and bug fixing phases, it should be released to the users [1]. Various test environments are built under controlled conditions such that the performance, stability and error handling of the software can be tested and the results are evaluated. In this manner the software is tested within various applications. Checking when the client's requirements are met and the standards are accomplished, software testing is done. Thus, when the requirements of a user are met completely, the software is known to be of good quality.

It is seen that the properties of resources, or the manufacturing processes included do not affect the software systems due to which they are known as abstract and intangible in nature. Since the potentiality of the software has no limits, the software engineering becomes easier. However, they are highly complex, are not easy to be understood and require huge costs when modifications are to be made due to the absence of physical constraints within them [2].

### II. Introduction to Software Testing

An individual cannot perform the complete software testing process. Depending upon the size and complexity of the application on which testing is to be performed; a team is assigned certain tasks. If possible, there should be the least role of the programmers that have originally generated the application. This is due to the fact that an unbiased decision might not be possible to be taken by them since they have been completely involved within the product and know every detail of it in comparison to others [4].

It is important for the testers to be critical however non-judgmental and also must be careful, curious and must communicate their views accurately. It is not necessary that a good tester



will always be a good developer and same goes for the opposite. However, their capability to get their hands perfectly on the keyboards is one common trait that is shared by the testers and developers [5]. It is possible to miss the important design work in case if a developer is in hurry to complete his deadline. Due to this, he might miss some important criterion which will later be notified during the planning phase. It is important to gather the test design reviews similar to the code reviews, so that the time and effort for future can be saved

The highest utilization of the system similar to that of the business users will only be done by the testers within the IT section. Since it is to be made sure that the system is perfect as per the business side, there are business users recruited by the user testing initially only. The major issue here is that it is not possible for the expert users to identify any kind of problem since they do not have business experience. Only the issues identified by the expert users will be noticed and the other problems will be neglected which will not generate a good quality of product.

### **III. Regression Testing**

A testing in which each change within a developing or modifying application is validated consistently and repeatedly is known as regression testing. New errors, defects and problems arise from the potential each time one defect is fixed. The application must have the ability to repeat everything that was correct until the point of failure is reached which results in introducing an element of uncertainty. The selective retesting of an application that has been changed lately is known as regression testing. To prevent any kinds of failures within components or features that already exist due to the occurrence of repairs, this type of testing is performed.

Along with the other tests this testing is performed parallel. It also ensures that the specified requirements of the system are still being met when a newly modified code is generated and no adverse effects have been caused by the modifications [8]. To ensure that a particular defect has been fixed or not, this type of testing is not performed. It is ensured here that any kinds of modifications have not affected the rest of the application.

### **IV. Test Case Prioritization**

It is favourable to prioritize the test suite which consists of large number of test cases such that the time and cost spent on testing can be reduced to the significant amount. The test cases are executed in a specific order through the explicit planning of Test case prioritization (TCP). Thus, within the software process, the rate of fault detection is enhanced through the increase in effectiveness of software testing activities. Primarily, the regression testing efforts were improved using TCP. In order to assure that no unintended effects have been made to the system code and the system works as per the specified requirements by the modifications, the system of component is retested within regression testing. It is important to perform software testing through the test case prioritization process due to the following factors:

- a. There is large amount of time and cost consumed when running the regression testing phase.
- b. For running the entire test suite again, enough time or resources are not available.
- c. The order in which the test cases are made to run is not decided here.



For maximizing the objective function, the test cases are prioritized and scheduled using test case prioritization techniques. The test cases are scheduled and run as per the highest priority such that the faults can be detected earlier within these techniques.

## **i. Customer Requirement-based techniques.**

The techniques that prioritize of test cases on the basis of their requirement of documents are known as customer requirement-based techniques [6]. The custom-priority, required complexity and volatility are some amongst the various weight factors being utilized here. The test cases can be weighted using several factors such as customer-assigned priority (CP), requirements complexity (RC) and requirements volatility (RV). Further, to provide measurements for each factor, values from 1 to 10 are assigned. The need of prioritization of test case in relevance to a requirement can be indicated by the higher factor values.

## **ii. Coverage-based techniques.**

The techniques in which the test cases are prioritized on the basis of coverage criteria are known as coverage-based techniques. The practitioners use this type of analysis within the software testing and it is known there as code coverage analysis. The quantity of source code of a program at the time of testing is described by it. The direct inspection of code is done in this form of testing and thus it is also known as a white-box testing type of testing [5].

## **iii. Cost Effective-based techniques.**

The prioritization of test cases on the basis of costs such as the cost required for analysis and prioritization is done by applying cost-effective-based techniques. The resources that perform execution and validation are used to determine the cost of a test case relevant to the resource. The severity of each fault can be revealed by a test case for the cost-cognizant prioritization. For testing the similar criterion mentioned above, the fault severity might be utilized.

## **iv. Chronographic history-based techniques.**

The techniques that are utilized for prioritizing the test cases on the basis of history of test execution, chronographic history-based techniques are applied [2]. There is no availability of source code related information in case when the black box environment is tested. Here, the output of test cases and other run-time information is only provided to the practitioners. The initialization of a test suite using test history and then arranging the order to the remaining test cases on the basis of run-time information is one particular method used for prioritization of black box testing.

## **V. Conclusion**

Software testing is the process in which software is examined whether they are working accurately according to system specification and fulfilling the requirements of the users [3]. In the software development life cycle, testing is performed at the phase level. Regression testing takes place in the end when some changes are done in the project for future release. The test case prioritization is the technique of regression testing which is being applied to prioritize the test cases according to the defined changes. It has been observed that the rate at which faults are detected is increased and execution time is decreased by automated test case prioritization as compared to the manual test case prioritization in regression testing.



## References

- [1] C. Catal, "Software fault prediction: A literature review and current trends," *Expert Systems with Applications* vol. 38, pp. 4626-4636, 2011.
- [2] R. Malhotra, "A systematic review of machine learning techniques for software fault prediction," *Applied Soft Computing*, vol. 27, pp. 504-518, 2015
- [3] T. Menzies, B. Caglayan, E. Kocaguneli, J. Krall, F. Peters, and B. Turhan, "The promise repository of empirical software engineering data," West Virginia University, Department of Computer Science, 2012.
- [4] T. J. McCabe, "A complexity measure," *Software Engineering, IEEE Transactions on*, pp. 308-320, 1976.
- [5] M. H. Halstead, *Elements of Software Science (Operating and programming systems series)*: Elsevier Science Inc., 1977.
- [6] L. Guo, Y. Ma, B. Cukic, H.S.H. Singh, "Robust prediction of faultproneess by random forests," in: 15th Int. Symp. Softw. Reliab. Eng. 2004.
- [7] Kaur, R. Malhotra, "Application of random forest for predicting fault prone classes," in: International Conference on Advanced Computer Theory and Engineering, Thailand, December 20–22, 2008.
- [8] T. Khoshgoftaar, E. Allen, "Model software quality with classification trees," *Recent Adv. Reliab. Qual.Eng.*,2001.



## A Mathematical Analysis of Linear Algebra and the Matrix

Nupur Singh

Banarsidas Chandiwala Institute of Information Technology, GGSIPU, Delhi

Asst.Professor

nupur@bciit.ac.in

**Abstract:** *In this article, we provide an examination on the usage of matrices and linear algebra in arithmetic. The location of arithmetic referred to as linear algebra is dedicated to the examination of vectors, vector areas (additionally referred to as linear areas), linear mappings (additionally referred to as linear transformations), and linear equation structures. Since vector areas are a key idea in modern arithmetic, each summary algebra and useful evaluation regularly use linear algebra. Analytic geometry gives a concrete illustration of linear algebra, whilst operator concept generalises it.*

**Keywords:** n-tuple, vectors, linear equation, linear areas, linear algebra.

### I. Introduction

In the examine of vectors in Cartesian 2-area and 3-area, linear algebra first emerged. In this context, a vector is a directed line section this is described through its magnitude, or length, and direction. In order to create the primary instance of a real vector area, vectors ought to be brought to each other and increased through scalars. Vectors may be used to symbolize bodily factors inclusive of forces. The scope of modern linear algebra has been multiplied to recall areas with any range of dimensions. An n-area is a vector area with size n. The majority of sensible findings from 2- and 3-area are transferable to those better dimensional areas. even whilst visible belief is difficult.

The scalars that may be used to multiply a vector area detail on this summary context now no longer be numerical. The scalars ought to most effective integrate to shape a subject, that is a form of mathematical structure. This subject commonly refers back to the actual or complicated numbers subject in programs. In a manner this is like minded with the addition and scalar multiplication given at the vector area, linear maps switch factors from one linear area to another (or to itself) (s). A vector area is a hard and fast of all such transformations. Every linear remodel may be represented through a matrix, a desk of integers, if the idea for a vector area is fixed. the in-intensity exam of algorithmic characteristics.

#### 1) LINEAR ALGEBRA

A linear subspace is a not unusual place subject matter of examination in linear algebra and is represented as a line in  $R^3$  that runs through the origin (blue, thick). The examination of vectors, vector areas (additionally referred to as linear areas), linear mappings (additionally referred to as linear transformations), and linear equation structures is the challenge of linear algebra. Since vector areas are a key idea in modern arithmetic, each summary algebra and useful evaluation regularly use linear algebra.

Analytic geometry gives a concrete illustration of linear algebra, whilst operator concept generalises it. Since linear fashions may also regularly approximate nonlinear ones, it has numerous programs in each the medical and social sciences.





## 2) SOME USEFUL THEOREMS

- Every vector area has a basis
- Any bases of the identical vector area have the identical cardinality; equivalently, the size of a vector area is well-described.
- A matrix is invertible if and most effective if its determinant is nonzero.
- A matrix is invertible if and most effective if the linear map represented through the matrix is an isomorphism.
- If a rectangular matrix has a left inverse or a proper inverse then it's far invertible (see invertible matrix for different equal statements).
- A matrix is advantageous semidefinite if and most effective if every of its eigen values is extra than or same to zero.
- A matrix is advantageous particular if and most effective if every of its eigen values is extra than zero.
- An  $n \times n$  matrix is diagonalizable (i.e. there exists an invertible matrix  $P$  and a diagonal matrix  $D$  such that  $A = PD(P^{-1})$ ) if and most effective if it has  $n$  linearly unbiased eigenvectors.

## 3) LINEAR EQUATION:

In an algebraic equation, a linear equation is one wherein every time period is both a consistent or the end result of the made of a consistent and (the primary electricity of) an unmarried variable. One or extra variables can be found in a linear equation. In maximum branches of arithmetic, and in particular in carried out arithmetic, linear equations are ubiquitous. They are enormously beneficial because many nonlinear equations can be transformed to linear equations by assuming that the portions of hobby most effective barely vary from some "background" condition, no matter the reality that they evidently exist whilst modelling many processes. Exponents aren't protected in linear equations. This article examines the scenario of an unmarried equation for which true answers are sought. Its complete data is applicable for classy answers and extra.

## 4) MATRIX:

In mathematics, a matrix is a rectangular array of numbers, as depicted to the right (plural matrices, or less frequently, matrixes). The term "tensor" is used to describe higher-dimensional, such as three-dimensional, arrays of numbers as opposed to higher-dimensional matrices with only one column or row. Matrices can be multiplied according to a rule that corresponds to the composition of linear transformations, as well as added and subtracted entrywise. Except for the fact that matrix multiplication is not commutative and can fail, these operations meet the common identities. The representation of linear transformations—higher-dimensional analogues of the linear functions of the type  $f(x) = cx$ , where  $c$  is a constant—is one application of matrices. The coefficients of a set of linear equations can also be tracked by matrices.

If the matrix is square, Matrix encoding is used in computer graphics to represent three-dimensional space on a two-dimensional display. Matrix calculus applies traditional analytical concepts like function derivatives and exponentials to matrices. In order to solve ordinary differential equations, the latter is frequently required. A square mathematical matrix is used by the 20th-century musical movements serialism and dodecaphonism to



determine the structure of musical intervals. Due to their ubiquitous application, a lot of work has been spent into developing effective matrix computing techniques, especially if the matrices are large. To do this, there exist a variety of matrix decomposition techniques that describe matrices as the products of other matrices with specific features, thereby theoretically and practically simplifying computations. Sparse matrices, or matrices primarily made up of zeros, can appear while simulating

## II. CONCLUSION

Modern physics heavily relies on linear transformations and the symmetries that go along with them. Since the application of quantum theory to analyse molecular bonding and spectroscopy, chemistry has used matrices in a variety of ways. In this article, we give a study on the use of matrices and linear algebra in mathematics. In an algebraic equation known as a linear equation, each term is either a constant or the result of multiplying a constant by one variable (to the first power). One or more variables may be present in a linear equation. The area of mathematics known as linear algebra is devoted to the study of vectors, vector spaces (also known as linear spaces), linear mappings (also known as linear transformations), and linear equation systems.

## REFERENCES

- [1] H. Anton, 5th ed of "Elementary Linear Algebra," New York: Wiley, (1985), ISBN 0-471-848190.
- [2] M. Artin, Algebra (Prentice Hall, 1991), ISBN 978-0-89871-510-1.
- [3] A. J. Baker, Matrix Groups: An Introduction to Lie Group Theory (Springer-Verlag, Berlin, DE; New York, NY, 2003), ISBN 978-1-85233-470-3.
- [4] D. Bau III and L. N. Trefethen, Numerical Linear Algebra (Society for Industrial and Applied Mathematics, Philadelphia, PA, 1995), ISBN 978-0-89871-361-9.
- [5] R. A. Beauregard and J. B. Fraleigh, A First Course in Linear Algebra: With Optional Introduction to Groups, Rings, and Fields (Houghton Mifflin Company, Boston, 1973), ISBN 0-395-14017- X.
- [6] Otto Bretscher Published Linear Algebra with Applications, in, 3rd ed, 1973 through Prentice Hall.
- [7] 'Matrix Methods: An Introduction,' by Richard Bronson Academic Press, New York, LCCN 70097490.

## Analysis of Research and Development of Tools & Expertise for IoT

### Forensics

Smriti Sharma

Assistant Professor, MCA department, GGSIPU University  
Banarsidas Chandiwala Institute of Information Technology  
Kalkaji, New Delhi, India  
Smritisharma3627@gmail.com

**Abstract:** The term 'Internet of Things' refers to everything other than a computer or mobile device that could connect to the internet. IoT describes the network of physical objects that are embedded with sensors, software and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. The extensive set of applications for IoT devices is often divided into consumer, commercial, industrial and infrastructure spaces. One of the key drivers of the IoT is data. The success of the idea of connecting devices to make them more efficient is dependent upon the access to and storage & processing of data. Companies working on IoT collect data from multiple sources and store it in their network for further processing. This leaves the door wide open for privacy and security dangers and single point of vulnerability of multiple systems. With the increased number of devices being connected to the internet benefits the society by improving livelihood and making things easier and better, the same tools are being exploited by cybercriminals in perpetrating various cybercrimes. In such cases, there is a need to collect forensic evidence from IoT devices that can be analysed and then presented in court as evidence. The evidences collected and analysed can also be used by cyber security agencies in the country for framing requisite policies, issuing advisories and generating alerts for the secure and safe cyberspace..

**Keywords:** Internet of Things (IoT), Digital Forensics (DF), Smart Grids (SG), Information and Communications Technology (ICT), Advanced metering Infrastructure (AMI), Technology Readiness Level (TRL), Programmable Logic Controller (PLC), Remote Terminal Unit (RTU), Industrial control Systems (ICS)

### I. Introduction

IoT forensics is a branch of digital forensics which deals with IoT-related cybercrimes and includes investigation of connected devices, sensors and the data stored on all possible platforms.

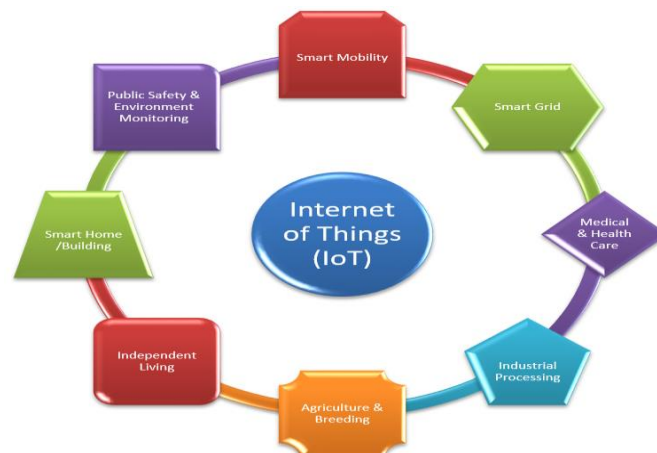
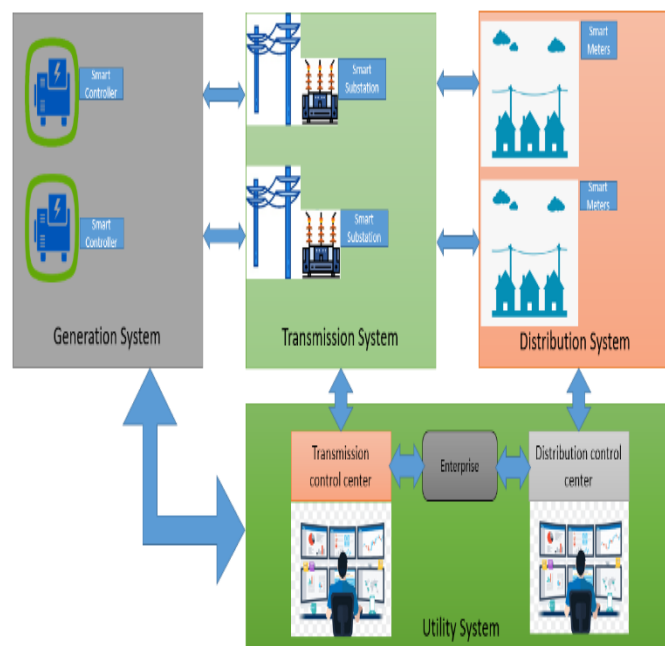


Figure 1: Various domains that usesIoT systems

IoT being ubiquitous, there are numerous domains that utilize IoT technology like Agriculture, Healthcare, Manufacturing, Transportation, Smart City and so on. As each of these domains itself have wide range of applications that are heterogeneous and system specific, to confine the scope, this concept paper focuses on IoT applications in Power utility sector, mainly Smart Grid (SG). SG is one of the most important application of IoT. The SG is the next generation of electrical network energy systems, which have been updated with communications, technology and connectivity to drive smarter resource use. Smart Grid is a data communication network which is integrated with the power grid to collect and analyse data that are acquired from transmission line, distribution substations and consumers. SG is used to reduce the electricity but at the same time the efficacy and transparency of the system is also enhanced. SG includes ICT applications such as Advanced metering Infrastructure (AMI), Substation Automation System, Energy Storage system, Home Automation Networks, Wide Area protection System, Distributed intelligent Agents etc. SG includes IoT application in all stages of a power grid like generation, transmission, distribution and Utility systems.



**Figure 2: Overall architecture of Smart Grid**

## II. Objectives

The objective of this concept paper is to highlight the need to take up projects for conducting research and development in IoT Forensics with Smart Grid in Power Utility Sector as case study which includes the following activities: -

- A. Study on IoT applications in Smart Grid (SG) and various products used for implementing these smart solutions
- B. Test bed setup of SG IoT systems for Vulnerability analysis and exploit development
- C. Study on forensic readiness of SG IoT applications and identification of potential data sources in these systems.



- D. Design and development of digital forensics tools for acquiring and examining data from all potential sources from selected IoT ecosystems in SG.

### III. Global Scenerio

Even though various digital forensics areas had attained maturity and have tools with advanced features, IoT forensics is still in its infancy. There is lack of methodology and framework for IoT forensics. IoT forensics still relies on methodologies and frameworks from standard digital forensics that is not fully adequate. There is lack of appropriate tools for IoT forensics. New software and hardware tools are needed. So, more research is necessary in this area and it is urgent need of the hour.

Approach for investigating IoT systems differ based on the forensic preparedness of the system. Most commercial IoT applications will put some security measures but this mainly lacks in majority of IoT applications since, now IoT systems are concentrating on applications and not security by design.

Following are some of the IoT forensics theoretical frameworks suggested by researchers globally.

- A. DFIF-IoT: Digital Forensic Investigation Framework for IoT
- B. The Last-on-Scene (LoS) Algorithms
- C. FSAIoT: Forensic State Acquisition model for IoT devices
- D. Application specific digital forensic Investigative model
- E. IoTdots: A digital forensics frameworks for Smart environments
- F. Privacy-aware IoT Forensics
- G. A Holistic Forensic Model for the IoT
- H. FEMS: Forensic Edge Management System
- I. FAIoT: Forensic Aware IoT model

The studies show that these frameworks are very specific and cannot serve as a comprehensive common IoT Forensics investigation model. The vast majority of modeling attempts lack proper experimental validation due to the unavailability of testing environment. Therefore, it is necessary to identify adequate no: of IoT environments from heterogeneous domains to devise the SOP.

In most of the experiments done on IoT forensics by researches around the globe, mainly focus on the data extraction and analysis using existing open-source tools. None of these research experiments covers all the potential data sources of the IoT ecosystem which they are focused on. They conclude with some limitations and future works due to the lack of tools and retaining some of the data sources untouched. This point out the extreme necessity of tools for IoT forensics investigation. The open-source tools presently available are mostly application or system specific which limits the generic usage of these tools. Most of these open-source tools are mainly for consumer applications like Alexa ecosystem, smart hub etc. There are very less or no tools for investigating incidents in IoT applications in Smart Grid. This makes an investigator unable to establish a correlation between multiple sources of evidence which makes their investigation time-consuming and difficult.



There are no commercial tools for IoT forensics. This project shall bring out aIoT forensic tool kit that is generic so that this kit shall be used for investigating in various IoT ecosystems in Power Utility sector.

#### IV. Challenges & Opportunities

‘Things’ in IoT might be devices with permanent storage with familiar file systems and file formats. The most of the ‘things’ use proprietary file systems and formats. They might not even have permanent memory that holds user data and a limited power supply. These devices will have only limited amount of RAM and transfer all their data immediately. That data can be transferred in an open standard or a proprietary closed format. Network data can be encrypted. IoT data is often processed in the server located in a different location. All this makes IoT forensics different and more challenging than traditional digital forensics.

The heterogeneous nature of IoT infrastructure makes the forensic approaches domain specific. As the IoT application differs, devices, hardware used, their interfaces, connectivity etc changes and leads to the need of a set of tools to address the vast domains in IoT. Based on the characteristics of IoT devices their structures differ by model and are miniaturised. There will be less or no hardware ports in IoT devices to acquire data in a forensically sound manner. In Smart Grid IoT applications both volatile and non-volatile, open-source and proprietary systems are involved in transactions and data flows. Therefore, digital forensics for embedded, Cloud and IoT devices is intense and challenging. The use of privacy and security techniques like encryption often inhibits or delays successful digital forensic investigations.

On the other hand, IoT brings a set of opportunities. IoT brings new sources of evidence to general forensics. IoT records events from the physical environment which were not recorded and stored before. These data are stored as digital data that enables much easier search, filtering, cross-relating, aggregation and other data operations that are helpful in turning data into evidence. IoT systems can contain contextual evidence collected without the individual who committed the crime being aware. IoT evidence, both for physical and digital forensics is harder to destroy. Also, it usually is not just one piece of evidence and it is generally stored as client-side artefacts, server-side artefacts, logs etc that are out of the reach of people who may want to delete it. In that sense, IoT forensics increases the scope of work than traditional forensics.

As there will be rise in Smart Grid projects in the coming years, the possibility of IoT attacks is more. So, the forensic community must be prepared in advance for acquiring and examination of forensically relevant data from these systems. Even though there are few open-source tools and isolated experiments conducted in IoT forensics, there are no commercial tools or procedures in IoT forensics so far.

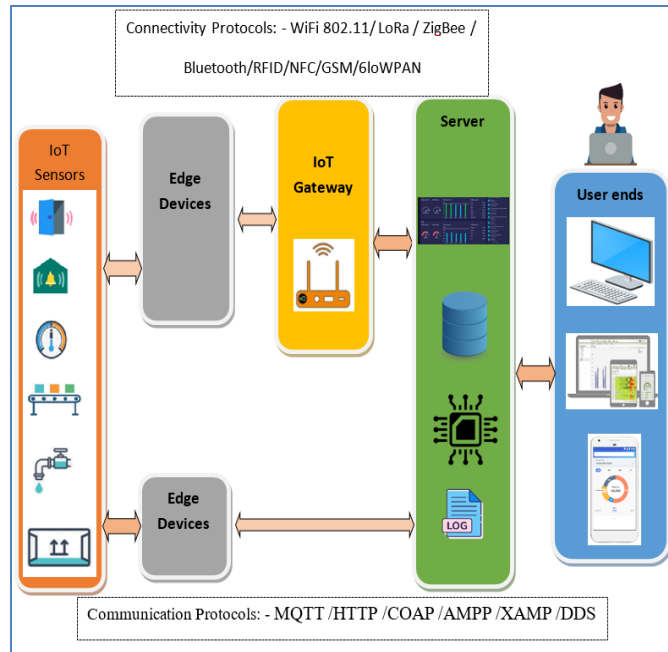
#### V. Brief Outline

##### A. *IoT environment and architecture*

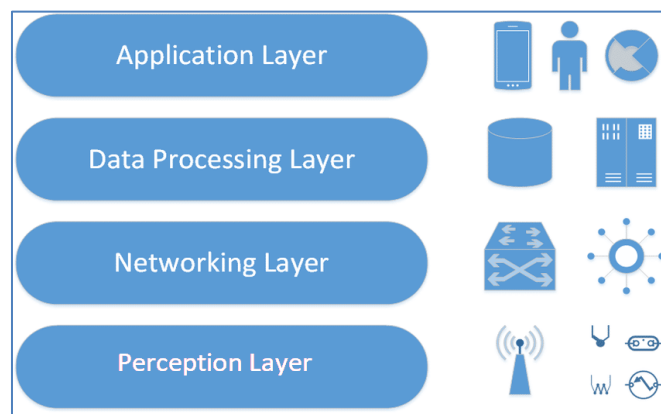
There are diverse applications for IoT and based on that, there are various types of IoT environments. Some of the IoT applications are Smart city, Smart grids, Industrial internet, connected health, smart retail, smart supply chain, smart farming, Intelligent transportation systems and so on. Even though there are many IoT systems, the typical primary functional layers in an end-to-end IoT stack can be arrived to a common architecture as shown in figure 3. The four-layer IoT Architecture shown in figure 4 has four fundamental building blocks - Perception layer, Network layer, application layer and data layer. The perception layer



includes sensors, actuators and edge devices that interact with the environment. The network layer discovers, connects and translates devices over a network and in coordination with the application layer. The application layer does the data processing and storage with specialized services and functionality for users. The data layer includes data at rest located in IoT edge devices, gateways, servers and at user end devices.



**Figure 3: Generic Architecture of an IoT ecosystem**



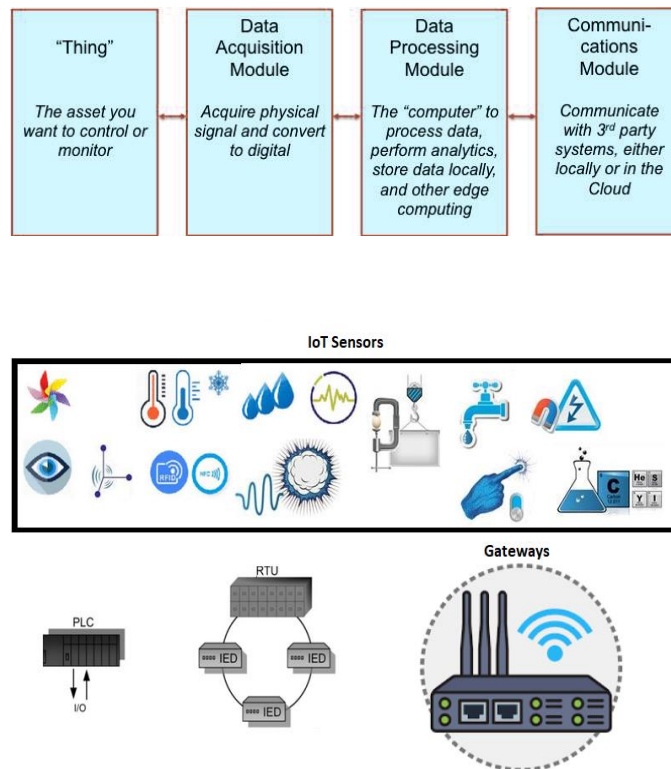
**Figure 4: The four-layer IoT architecture**

**B. IoT building blocks and event data artefacts**

An IoT system is a system in which data is created under the control of objects or entities and forwarded or sent across a network. An IoT building block or IoT components is an essential unit or an enabler technology on which IoT system is constructed. IoT components can be broadly classified into three categories hardware devices, software and protocols.

1. **Hardware devices:** In IoT architecture the bottom layer includes the hardware devices which interact with the physical world through sensors, actuators, RFID etc. These hardware devices also known as edge devices will have sensors, Data processing

module and communication module. Based on the IoT application along with IoT edge devices, other devices like (programmable logic unit) PLC, (Remote Terminal Unit) RTU, Intelligent Electronic device (IED), communication gateway etc. will also be present in an IoT environment. IoT gateways can be a physical device or software program that serves as the connection point between the cloud and controllers, sensors and intelligent devices. Some IoT gateways do more than just route traffic. A gateway device can sometimes be used to pre-process that data locally at the edge before sending it to the cloud. In doing so, the device might de-duplicate, summarize or aggregate data as a way of reducing the volume of data that must be forwarded to the cloud.



**Figure 5: IoT Hardware devices**

2. **Software:** The software component of the IoT system includes operating systems and firmware in IoT devices, middle-ware, server application, logs, databases, gateway application and so on. The software/ firmware in IoT edge device manages sensing, measurements, aggregation of data from multiple device and distributes it in accordance with settings and transmits all collected data to a central server. The software for the IoT network ensures the necessary cooperation and stable networking between devices. It manages the various applications, protocols and limitation of each device to allow communication. The application software in servers analyse information based on various settings and designs in order to perform automation-related tasks or provide the data required by industry.
3. **Protocols:** IoT protocols are a crucial part of the IoT system and they enable the IoT components (sensors, devices, gateways, servers and user applications) to exchange data in a structure and meaningful way. These include protocols for connectivity,



routing, networking, service discovery, communication and server protocols. Appropriate protocols are used to ensure the flow of data between devices so as to minimize latency. The communication protocols that used between applications and back end systems are HTTP, SQL, FTP, SNMP, SOAP, XML, SSH and SMTP. The protocols that are used between back-end systems and field devices are MQTT, XMPP, RESTful HTTP, CoAP, SNMP, IPv4/6, BACnet, LONworks, LoRa, Fixed, 2G/3G/4G/5G, Wi-Fi, WiMax, Zigbee, ESTI LTN, 6LowPAN, ModBus, 802.15.4, RFID, NFC, Bluetooth, Dash7. ISM & short-range bands.

IoT Forensics is a sub division of digital forensics (DF). DF discipline has long been in both academia and industry, but IoT forensics is a relatively new and unexplored area. Like DF, IoT forensics is to identify and extract digital information from an IoT environment in a legal and forensically sound manner. It includes gathering of data from IoT hardware devices like edge devices, gateways, logs from the server end and user end devices. In IoT forensics the sources of evidence will be much more wide-ranging depending on the type of IoT system under investigation.

## VI. CONCLUSION

The fast pace of development and nature of IoT environments bring a variety of security and forensics challenges. It has become a necessity to develop in house expertise and suite of tools to investigate IoT-related incidents. As there are no defined principles for IoT forensics, investigations will rely on the nature of the IoT device and identifying sources of data in IoT system. Due to the heterogeneous nature and the ways in which data is distributed, aggregated and processed there are challenges in digital forensics investigation of an IoT system especially considering the criticality of Smart Grids.

This analysis of digital forensics tools helps for data extraction and analysis from selected IoT applications in Smart Grid of power utility sector.

## References

- [1] IoT Forensics: An Overview of the Current Issues and Challenges by TharminiJanarthanan , ShahrzadZargari and Maryam Bagheri. ( Jan 2021)
- [2] A Survey on the Internet of Things (IoT) Forensics: Challenges, Approaches, and Open Issues by Maria Stoyanova , YannisNikoloudakis , SpyridonPanagiotakis , EvangelosPallis, and Evangelos K. Markakis. (2020)
- [3] The internet of things in the power sector opportunities in asia and the pacific. byarunramamurthy and pramodjain. ADB sustainable development working paper series vol 48, 2017.



## A Review On Data Mining Tools And Techniques –Application In Medical Science

Sonia Batra

Banarsidas Chandiwala Institute of Information Technology, Delhi, India  
sonia@bciit.ac.in

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**Abstract:** *The paper is based on the Study of various data mining techniques and tools that are used in Medical Science. In the given study we have elaborated the techniques with respect to breast cancer. The major goal of the classification technique is to predict the target class accurately for each case in the data. The present study is focused on the usage of classification techniques in the field of medical science and bioinformatics. The goal of data mining application is to turn that data which are in the form of facts, numbers, or text which can be processed by a computer into knowledge or information. The main purpose of data mining application in healthcare systems is to develop an automated tool for identifying and disseminating relevant healthcare information. Breast cancer is one of the leading cancers for women in developed countries including India. It is the second most common cause of death due to cancer in women. The high incidence of breast cancer in women has increased significantly in the last year. Finally, the existing data mining techniques with data mining algorithms and its application tools which are more valuable for healthcare services are discussed in detail.*

**Keywords:** *Data Mining, Classification*

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### I. Introduction

Knowledge discovery in databases is well-defined process consisting of several distinct steps. Data mining is the core step, which results in the discovery of hidden but useful knowledge from massive databases. Quality service implies diagnosing patients correctly and administering treatments that are effective. Poor clinical decisions can lead to disastrous consequences which are therefore unacceptable. Treatment records of millions of patients can be stored and computerized and data mining techniques may help in answering several important and critical questions related to health care.

The availability of integrated information via the huge patient repositories, there is a shift in the perception of clinicians, patients and payers from qualitative visualization of clinical data by demanding a more quantitative assessment of information with the supporting of all clinical and imaging data. For instance it might now be possible for the physicians to compare diagnostic information of various patients with identical conditions. The term Kidney failure and heart disease applies to a number of illnesses that affect the circulatory system, which consists of heart and blood vessels. It is intended to deal only with the condition and the factors, which lead to such condition. Acute kidney injury (also called acute renal failure) means that your kidneys have suddenly stopped working. Your kidneys remove waste products and help balance water and salt and other minerals in your blood. When your kidneys stop working, waste products, fluids, and electrolytes build up in your body. This can cause problems that can be deadly.



Symptoms of Heart Disease: 1. Dizzy spell or fainting fits. 2. Discomfort following meals, especially if long continued. 3. Shortness of breath, after slight exertion. 4. Fatigue without otherwise explained origin. 5. Pain or tightness in the chest a common sign of coronary insufficiency is usually constrictive in nature and is located behind the chest bone. 6. Radiation into the arms or a sense of numbness or a severe pain in the centre of the chest. 7. Palpitation. Heart disease is a general term that means that the heart is not working accurately. There are different kinds of heart disease like congenital heart diseases, acquired heart diseases, Coronary artery disease (CAD). Coronary artery disease (CAD) is the most frequent type of heart disease. About 80% of deaths occurred in low- and middle income countries due to heart diseases. It is predicted that if this trend continue then till 2030 around 23.6 million people will die from cardiovascular diseases (that's heart strokes & heart attacks. It is the leading cause of death among males as well as females. This research analyzes how data mining techniques are used for predicting different types of diseases

## II. Data Mining

A process used by companies to turn raw data into useful information. By using software to look for patterns in large batches of data, businesses can learn more about their customers and develop more effective marketing strategies as well as increase sales and decrease costs. Data mining depends on effective data collection and warehousing as well as computer processing. Data mining is sorting through data to identify patterns and establish relationships. Data mining parameters include: 1. Association - looking for patterns where one event is connected to another event. 2. Sequence or path analysis - looking for patterns where one event leads to another later event. 3. Classification - looking for new patterns (May result in a change in the way the data is organized but that's ok) 4. Clustering - finding and visually documenting groups of facts not previously known 5. Forecasting - discovering patterns in data that can lead to reasonable predictions about the future (This area of data mining is known as predictive analytics).

Data mining techniques are used in a many research areas, including mathematics, cybernetics, genetics and marketing. Web mining, a type of data mining used in customer relationship management (CRM), takes advantage of the huge amount of information gathered by a Web site to look for patterns in user behaviour. Models house the steps, modules, and resources of the data mining process. Some data mining models include the entire process for a particular purpose, be it to cluster or predict. A model is, however, different from an algorithm. An algorithm is a specific, mathematically driven data mining function, such as a neural network, classification and regression tree (C&RT), or K-means.

The core functionalities of data mining are applying various methods and algorithms in order to discover and extract patterns of stored data. From the last two decades data mining and knowledge discovery applications have got a rich focus due to its significance in decision making and it has become an essential component in various organizations. The field of data mining have been prospered and posed into new areas of human life with various integrations and advancements in the fields of Statistics, Databases, Machine Learning, Pattern Reorganization and healthcare.

Each data mining technique serves a different purpose depending on the modeling objective. Naïve Bayes is one of the successful data mining techniques used in the diagnosis of heart disease patients . Naive Bayes classifiers have works well in many complex real-world situations. Naive Bayes or Bayes Rule is the basis for many machine-



learning and data mining methods. The rule is used to create models with predictive capabilities. It provides new ways of exploring and understanding data. It learns from the “evidence” by calculating the correlation between the target (i.e., dependent) and for other (i.e., independent) variables. By theory, this classifier has minimum error rate but it may not be case always. However, inaccuracies are caused by assumptions due to class conditional independence and the lack of available probability data. Observations show that Naïve Bayes performs consistently before and after reduction of number of attributes.

### III. Case Study

#### Heart Disease

Cardiovascular disease (also called heart disease) is a class of diseases that involve the heart, the blood vessels (arteries, capillaries, and veins) or both. Cardiovascular disease refers to any disease that affects the cardiovascular system, principally cardiac disease, vascular diseases of the brain and kidney, and peripheral arterial disease. The causes of cardiovascular disease are diverse but atherosclerosis and/or hypertension are the most common. In addition, with aging come a number of physiological and morphological changes that alter cardiovascular function and lead to increased risk of cardiovascular disease, even in healthy asymptomatic individuals. Cardiovascular disease is the 8 leading cause of deaths worldwide, though, since the 1970s, cardiovascular mortality rates have declined in many high-income countries . At the same time, cardiovascular deaths and disease have increased at a fast rate in low- and middle-income countries. Although cardiovascular disease usually affects older adults, the antecedents of cardiovascular disease, notably atherosclerosis, begin in early life, making primary prevention efforts necessary from childhood. There is therefore increased emphasis on preventing atherosclerosis by modifying risk factors, for example by healthy eating, exercise, and avoidance of smoking tobacco.

Evidence suggests a number of risk factors for heart diseases: age, gender, high blood pressure, hyperlipidemia, diabetes mellitus, tobacco smoking, excessive alcohol consumption, sugar consumption, family history, obesity , lack of physical activity, psychosocial factors, and air pollution. While the individual contribution of each risk factor varies between different communities or ethnic groups the consistency of the overall contribution of these risk factors to epidemiological studies is remarkably strong. Some of these risk factors, such as age, gender or family history, are immutable; however, many important cardiovascular risk factors drug treatment and prevention are modifiable by lifestyle change, social change, drug treatment and prevention of Serrano's Cardiac Triad: hypertension, hyperlipidemia, and diabetes. Coronary heart disease is a narrowing of the small blood vessels that supply blood and oxygen to the heart. This is also called as coronary artery disease. Coronary heart disease is usually caused by a condition called atherosclerosis, which occurs when fatty material and a substance called plaque builds up on the walls of arteries. This causes them to get narrow. As the coronary arteries narrow, blood flow to the heart can slow down or stop, causing chest pain, shortness of breath, heart attack, and other symptoms. Men in their 40's have higher risk of Coronary heart disease than women, but as women gets older, their risk increases so that it is almost equal to a man's risk. Major risk factors for Coronary heart disease are 1) Diabetes 2) High blood pressure 3) High LDL (bad) cholesterol 4)low LDL (good) cholesterol 5) Not getting enough physical activity6) Obesity7) Smoking.





Symptoms of Heart Disease: 1. Dizzy spell or fainting fits. 2. Discomfort following meals, especially if long continued. 3. Shortness of breath, after slight exertion. 4. Fatigue without otherwise explained origin. 5. Pain or tightness in the chest a common sign of coronary insufficiency is usually constrictive in nature and is located behind the chest bone with 6. Radiation into the arms or a sense of numbness or a severe pain in the centre of the chest. 7. Palpitation.

**Attributes taken for heart disease are:**

1. Age - Older age is a risk factor for heart disease. In fact, about 4 of every 5 deaths due to heart disease occur in people older than 65. As we age, our hearts tend not to work as well. The heart's walls may thicken and arteries may stiffen and harden, making the heart less able to pump blood to the muscles of the body. Because of these changes, the risk of developing cardiovascular disease increases with age. Because of their sex hormones, women are usually protected from heart disease until menopause, and then their risk increases. Women 65 and older have about the same risk of cardiovascular disease as men of the same age.

2. High Blood Pressure (Hypertension) - High blood pressure increases your risk of heart disease, heart attack, and stroke. Although other risk factors can lead to high blood pressure, you can have it without having other risk factors. If you are obese, smoke, or have high blood cholesterol levels along with high blood pressure, your risk of heart disease or stroke greatly increases. Blood pressure can vary with activity and age, but a healthy adult who is resting should have a systolic pressure below 120 and a diastolic pressure below 80.

3. Cholesterol : Cholesterol is produced by the liver and also made by most cells in the body. It is carried around in the blood by little 'couriers' called lipoproteins. We need a small amount of blood cholesterol because the body uses it to: build the structure of cell membranes. Make hormones like estrogen, testosterone and adrenal hormones. Help your metabolism work efficiently, for example, cholesterol is essential for your body to produce vitamin D. Produce bile acids, which help the body digest fat and absorb important nutrients.

4. Chest pain - Chest pain (angina) or discomfort caused when your heart muscle doesn't get enough oxygen-rich blood. It may feel like pressure or squeezing in your chest. The discomfort also can occur in your shoulders, arms, neck, jaw, or back. Angina pain may even feel like indigestion. But, angina is not a disease. It is a symptom of an underlying heart problem and is usually a symptom of coronary heart disease (CHD). There are many types of angina, including acute coronary syndrome, angina pectoris, chest pain, coronary artery spasms, microvascular angina, Prinzmetal's angina, angina inversa, stable or common angina, unstable angina and variant angina.

5. Thyroid - The thyroid gland, a small gland located in the neck just below your Adam's apple, is responsible for regulating many vital bodily functions. By producing just the right amount of thyroid hormone, the thyroid helps to regulate your body's metabolism – most importantly, how much oxygen and energy your body uses - as well as your digestive function, muscle function, and skin tone. In fact, the thyroid has at least some effect on every organ in the body - including the heart. For people with almost any type of heart disease, disorders of the thyroid gland can worsen old cardiac symptoms or cause new ones, and can accelerate the underlying heart disorder.

6. Stress - More research is needed to determine how stress contributes to heart disease — the leading killer of Americans. But stress may affect behaviours and factors that are



proven to increase heart disease risk: high blood pressure and cholesterol levels, smoking, physical inactivity and overeating. And stress may hurt your head, strain your back and make your stomach hurt. It can also zap your energy, wreak havoc on your sleep and make you feel cranky, forgetful and out of control. A stressful situation sets off a chain of events. Your body releases adrenaline, a hormone that causes your breathing and heart rate to speed up and your blood pressure to rise. These reactions prepare you to deal with the situation — the "fight or flight" response. When stress is constant, your body remains in high gear off and on for days or weeks at a time. Although the link between stress and heart disease isn't clear, chronic stress may cause some people to drink too much alcohol which can increase your blood pressure and may damage the artery walls.

## IV. Literature Survey

[1]Qeethara Kadhim Al-Shayea proposed evaluate artificial neural network in disease diagnosis. Two cases are studied. The first one is acute nephritis disease; data is the disease symptoms. The second is the heart disease; data is on cardiac Single Proton Emission Computed Tomography (SPECT) images. Each patient classified into two categories: infected and non-infected. Classification is an important tool in medical diagnosis decision support. Feed-forward back propagation neural network is used as a classifier to distinguish between infected or non-infected person in both cases. The results of applying the artificial neural networks methodology to acute nephritis diagnosis based upon selected symptoms show abilities of the network to learn the patterns corresponding to symptoms of the person.

[2] Mohd Khalid Awang<sup>1</sup> and Fadzilah Siraj proposed to assess the application of artificial neural network in predicting the presence of heart disease, mainly the angina in patients. The prediction and detection of angina are significant in determining the most appropriate form of treatment for these patients. The development of the application involves three main phases. The first phase is the development of Heart Disease Management Information System (HDMIS) for data collection and patient management. Then followed by the second phase, which is the development of Neural Network Simulator (NNS) using back propagation neural network for training and testing. The final phase is the development of Prediction System (PS) for prediction on new patient's data.

[3] Irfan Y. Khan, P.H. Zope, S.R. Suralkar proposed to evaluate artificial neural network [ANN] in disease diagnosis. ANN's are often used as a powerful discriminating classifier for tasks in medical diagnosis for early detection of diseases. ANN's are finding many uses in the medical diagnosis application. Two cases are studied. The first one is acute nephritis disease; data is the disease symptoms. The second is the heart disease. Data is on cardiac Single Proton Emission Computed Tomography (SPECT) images. Each patient classified into two categories: infected and non-infected. Classification is an important tool in medical diagnosis decision support. Feed-forward back propagation neural network is used as a classifier to distinguish between infected or non-infected person in both cases. The diagnosis is then determined by taking the whole available patients status into the account. Then depending on that, a suitable treatment is prescribed, and the whole process might be iterated. In each iteration, the diagnosis might be reconfigured, refined, or even rejected.

[4]Selvakumar.pdr.rajagopalan.s.p proposed the benefits and overhead of various neural network models for heart disease prediction. The generated information systems typically



consist of large amount of data. Health care organizations must have ability to analyze these data. The Health care system includes data such as resource management, patient centric and transformed data. Data mining techniques are used to explore, analyze and extract these data using complex algorithms in order to discover unknown patterns. Many data mining techniques have been used in the diagnosis of heart disease with good accuracy. Neural Networks have shown great potential to be applied in the development of prediction system for various type of heart disease. Data mining techniques are used for knowledge discovery in databases by extraction of interesting information such as non-trivial, hidden, previously unknown, potential useful and ultimately understandable knowledge or patterns from data's in large databases. Data mining provides different methodologies for decision-making, problem solving, analysis, planning, diagnosis, detection, integration, prevention, learning and innovation and forecasting.

[5] Parvathi I, Siddharth Rautaray Computer Science, KIIT University proposed data mining in general (e.g. Definition, tasks of data mining, application of data mining and gives a brief summarization of various data mining algorithms used for classification, clustering, and association. Discussion is made to enable the disease diagnosis and prognosis, and the discovery of hidden biomedical and healthcare patterns from related databases is offered along with a discussion of the use of data mining to discover such relationships as those between health conditions and a disease, relationships among diseases. It further discusses about the tool that can be used for the processing and classification of data and the advantages of WEKA(is a collection of machine learning algorithms for data mining tasks) the field of education data mining is tremendously used and is an emerging field . As every year millions of students are enrolled across the country with huge number of higher education aspirants, we believe that data mining technology can help bridging knowledge gap in higher educational systems. Data Mining helps to identify hidden patterns, associations, and anomalies from educational data and can improve decision making processes in higher educational systems.

[6]Hian Chye Koh and Gerald Tan proposed a data mining applications in healthcare. In particular, it discusses data mining and its applications within healthcare in major areas such as the evaluation of treatment effectiveness, management of healthcare, customer relationship management, and the detection of fraud and abuse. It also gives an illustrative example of a healthcare data mining application involving the identification of risk factors associated with the onset of diabetes. Finally, the article highlights the limitations of data mining and discusses some future directions. Data mining has been used intensively and extensively by many organizations. In healthcare, data mining is becoming increasingly popular, if not increasingly essential. Data mining applications can greatly benefit all parties involved in the healthcare industry. For example, data mining can help healthcare insurers detect fraud and abuse healthcare organizations make customer relationship management decisions, physicians identify effective treatments and best practices, and patients receive better and more affordable healthcare services. The huge amounts of data generated by healthcare transactions are too complex and voluminous to be processed and analyzed by traditional methods. Data mining provides the methodology and technology to transform these mounds of data into useful information for decision making.

[7] Neelamadhab Padhy, Dr. Pragnyaban Mishra, and Rasmita Panigrahi proposed a variety of techniques, approaches and different areas of the research which are helpful and marked as the important field of data mining Technologies. As we are aware that many MNC's and large organizations are operated in different places of the different countries. Each place of operation may generate large volumes of data. Corporate decision makers



require access from all such sources and take strategic decisions. The data warehouse is used in the significant business value by improving the effectiveness of managerial decision-making. In an uncertain and highly competitive business environment, the value of strategic information systems such as these are easily recognized however in today's business environment, efficiency or speed is not the only key for competitiveness. This type of huge amount of data's is available in the form of tera- to peta-bytes which has drastically changed in the areas of science and engineering. To analyze, manage and make a decision of such type of huge amount of data we need techniques called the data mining which will transforming in many fields. This paper imparts more number of applications of the data mining and also focuses scope of the data mining which will helpful in the further research.

[8] B.Venkatalakshmi, M.V Shivsankar TIFAC-CORE, Pervasive Computing Technologies proposed to design and develop diagnosis and prediction system for heart diseases based on predictive mining. Number of experiments has been conducted to compare the performance of various predictive data mining techniques including Decision tree and Naïve Bayes algorithms. In this proposed work, a 13 attribute structured clinical database from UCI Machine Learning Repository has been used as a source data. Decision tree and Naive Bayes have been applied and their performance on diagnosis has been compared. Naïve Bayes outperforms when compared to Decision tree. Heart disease is a major health problem and it affects a large number of people. Cardiovascular Disease (CVD) is one such threat. Unless detected and treated at an early stage it will lead to illness and causes death. There is no adequate research focus on effective analysis tools to discover relationships and trends in data especially in the medical sector. Health care industry today generates large amounts of complex clinical data about patients and other hospital resources. Data mining techniques are used to analyze this rich collection of data from different perspectives and deriving useful information.

[9]Thirumal P. C. and Nagarajan N. proposed a study on Data mining looks through a large amount of data to extract useful information. The most important and popular data mining techniques are classification, association, clustering, prediction and sequential patterns. In health concern businesses, data mining plays an important role in early prediction of diseases. In general to detect a disease numerous tests must be conducted in a patient. The usage of data mining techniques in disease prediction is to reduce the test and increase the accuracy of rate of detection. One of the most common diseases among young adult is Diabetes mellitus. This develops at a middle age and more common in obese children and adolescents. In order to reduce the population with diabetes mellitus it should be detected at an earlier stage, hence a quick and efficient detection mechanism has to be discovered. The principle of this study is to apply various data mining techniques which are noteworthy to prediction of diabetes mellitus and extract hidden patterns from the PIMA Indian diabetes dataset available at UCI Machine Learning Repository.

[10]M. Durairaj, V. Ranjani proposed to compare a variety of techniques, approaches and different tools and its impact on the healthcare sector. The goal of data mining application is to turn that data into facts, numbers, or text which can be processed by a computer into knowledge or information. The main purpose of data mining application in healthcare systems is to develop an automated tool for identifying and disseminating relevant healthcare information. This paper aims to make a detailed study report of different types of data mining applications in the healthcare sector and to reduce the complexity of the study of the healthcare data transactions. Also presents a comparative study of different



data mining applications, techniques and different methodologies applied for extracting knowledge from database generated in the healthcare industry. Finally, the existing data mining techniques with data mining algorithms and its application tools which are more valuable for healthcare services are discussed in detail. This study mainly discusses the Data Mining applications in the scientific side. Scientific data mining distinguishes itself in the sense that the nature of the datasets is often very different from traditional market driven data mining applications. In this work, a detailed survey is carried out on data mining applications in the healthcare sector, types of data used and details of the information extracted. Data mining algorithms applied in healthcare industry play a significant role in prediction and diagnosis of the diseases.

## V. Conclusion

The paper presents an overview of the data mining techniques used in medical investigation. It presents a survey of the tools and techniques and the causes of heart failure the major cause of deaths in today's world. It also reveals the major cause of symptoms of heart disease and the factors that are contributing to a deadly disease.

## VI. Future Work

In future it can be implemented for more diseases so that it helps to detect about other disease too. It can be refined more by using the Artificial Intelligence in future. If all the factors of a disease are considered, it will provide more fine result.

## References

- [1] Qeethara Kadhim Al-Shayea MIS Department, Al-Zaytoonah University of Jordan Amman, Jordan "Artificial Neural Networks in Medical Diagnosis" IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 2, March 2011 ISSN (Online): 1694-0814.
- [2] Mohd Khalid Awang<sup>1</sup> and Fadzilah Siraj Faculty of Informatics, University of Sultan Zainal Abidin, Gong Badak Campus, 21300 Kuala Terengganu, Terengganu, Malaysia "Utilization of an Artificial Neural Network in the Prediction of Heart Disease" International Journal of Bio-Science and Bio-Technology Vol. 5, No. 4, August, 2013
- [3] Irfan Y. Khan, P.H. Zope, S.R. Suralkar Dept. of Ele. & Tele. SSBT's college of Engg. & Tech, Bambhori, Jalgaon "Importance of Artificial Neural Network in Medical Diagnosis disease like acute nephritis disease and heart disease" ISSN: 2319-5967 ISO 9001:2008 Certified International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 2, Issue 2, March 2013
- [4] SELVAKUMAR.P, DR.RAJAGOPALAN.S.P Assistant Professor, ARM College of Engineering and Technology, Chennai Tamil Nadu, Professor, GKM College of Engineering and Technology "A SURVEY ON NEURAL NETWORK MODELS FOR HEART DISEASE PREDICTION" Journal of Theoretical and Applied Information Technology 20th September 2014. Vol. 67 No.2 © 2005 - 2014 JATIT & LLS. All rights reserved.ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195
- [5] Parvathi I, Siddharth Rautaray Computer Science, KIIT University Bhubaneswar,Odisha,India "Survey on Data Mining Techniques for the Diagnosis of Diseases in Medical Domain" Parvathi I, et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (1) , 2014, 838-846.
- [6] Hian Chye Koh and Gerald Tan "Data Mining Applications in Healthcare" Journal of Healthcare Information Management — Vol. 19, No. 2





- [7] Neelamadhab Padhy, Asst. Professor, Gandhi Institute of Engineering and Technology, GIET, Gunupur Dept. of Computer Science, Dr. Pragyan Mishra CMJ University, Meghalaya (Silong) a research Scholar Associate Professor, Gandhi Institute of Engineering and Technology, GIET, Gunupur Rasmita Panigrahi Lecturer, Gandhi Institute of Engineering and Technology, GIET, Gunupur “The Survey of Data Mining Applications And Feature Scope” International Journal of Computer Science, Engineering and Information Technology (IJCEIT), Vol.2, No.3, June 2012
- [8] B.Venkatalakshmi, M.V Shivsankar TIFAC-CORE, Pervasive Computing Technologies, Velammal Engineering College, Chennai “Heart Disease Diagnosis Using Predictive Data mining” K.L.N. College of Engineering, Madurai, Tamil Nadu, India ISSN (Online) : 2319 – 8753 ISSN (Print) : 2347 – 6710 International Journal of Innovative Research in Science, Engineering and Technology Volume 3, Special Issue 3, March 2014 International Conference on Innovations in Engineering and Technology
- [9] Thirumal p. C. And nagarajan n. Department of it, coimbatore institute of engineering and technology, coimbatore, tamil nadu “utilization of data mining techniques for diagnosis of diabetes mellitus - a case study” vol. 10, no. 1, january 2015 issn 1819-6608 arpn journal of engineering and applied sciences ©2006-2015 asian research publishing network (arpn). All rights reserved.
- [10] M.durairaj, v. Ranjani “data mining applications in healthcare sector: a study” international journal of scientific & technology research volume 2, issue 10, october 2013 issn 2277-8616 29 ijstr©2013.
- [11] Yuri Demchenko, " Addressing Big Data Issues in Scientific Data Infrastructure", 978-1-4673-6404-1/13 ©2013 IEEE.
- [12] Antonia Azzini, " Consistent Process Mining Over Big Data Triple Stores", 2013 IEEE International Congress on Big Data 978-0-7695-5006-0/13 © 2013 IEEE.
- [13] Zibin Zheng, " Service-generated Big Data and Big Data-as-a-Service: An Overview", 2013 IEEE International Congress on Big Data 978-0-7695-5006-0/13 © 2013 IEEE.
- [14] P. Eredics\* and T.P. Dobrowiecki, Data Cleaning for an Intelligent Greenhouse 6th IEEE International Symposium on Applied Computational Intelligence and Informatics • May 19–21, 2011.
- [15] R. Arora, P. Pahwa, S. Bansal, "Alliance Rules of BigdataCleansing", IEEE , International Conference on Signal Processing Systems, Singapore, May 2009, Page(s): 743 –747
- [16] S. Chaudhuri, K. Ganjam, V. Ganti, “Data Cleaning in Microsoft SQL Server 2005”, In Proceedings of the ACM SIGMOD Conference, Baltimore, MD, 2005
- [17] S. Reddy, A. Lavanya, V. Khanna, L.S.S. Reddy, “Research Issues on Bigdata Maintenance”, IEEE, ICACC '09. International Conference Advanced Computer Control, Singapore, Jan 2009, Page(s):623 – 627
- [18] S.E. Madnick, Y.W. Lee, R.Y. Wang, and H. Zhu, “Overview and framework for data and information quality research”, ACM, Journal of Data and Information Quality, Vol. 1, No. 1, Article 2, June 2009.
- [19] Sang-goo Lee, Seoul Nat, Univ Seoul, “Challenges and Opportunities in Information Quality”, E-Commerce Technology and the 4th IEEE International Conference on Enterprise Computing, E-Commerce, and E-Services, 2007, Tokyo, Jul 2007, Page(s): 481 – 481
- [20] Tom Johnsten and Robert B. Sweeney, “A Methodology for Hiding Knowledge in XML Document Collections”, Proceedings of the 27th Annual International Computer Software and Applications Conference (COMPSAC'03) 0730-3157/03 © 2003 IEEE
- [21] Xingzhi Sun, “A Border-Based Approach for Hiding Sensitive Frequent Itemsets”, Proceedings of the Fifth IEEE International Conference on Data Mining (ICDM'05) 1550-4786/05 © 2005
- [22] Yu et al. Yu Huang, Xiao-yi Zhang, Zhen Yuan, Guo-quan Jiang, “A universal data cleaning framework based on user model”, IEEE, ISECS International Computing, Communication, Control, and Management, Sanya, China, Aug 2009, Page(s): 200 – 202
- [23] [23] Timothy E. Ohanekwu, ”A Token-Based Data Cleaning Technique for Bigdata uSystems”.
- [24] [24] Research on Pattern Analysis and Data Classification Methodology for Data Mining and
- [25] Knowledge Discovery (2016) Heling Jiang1, An Yang, Fengyun Yan and Hong Miao.
- [26] [25] Research on the big data mining algorithm based on modified neural network and structure optimized genetic algorithm (2017)
- [27] [26] S.E. Madnick, Y.W. Lee, R.Y. Wang, and H. Zhu, “Overview and framework for data and information quality research”, ACM, Journal of Data and Information Quality, Vol. 1, No. 1, Article 2, June 2009.





## Cyber Security in India

Sandeep Jain

Banarsidas Chandiwala Institute of Information Technology, Delhi, India

[sandeep@bciit.ac.in](mailto:sandeep@bciit.ac.in)

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**Abstract:** *Cyber security has become a big security challenge in the age of ICT. As the dependency on ICT is increasing day by day across the globe, cyber threats appear likely to penetrate each and every corner of national economies and infrastructure. Meanwhile, ICT is used by some governments as both a strategic asset to be used for the purposes of national security and as a field of battle where strategic conflicts can be fought and won. India is continuously working in the field of cyber security to protect main governmental as well as private body of country.*

**Keywords:** *WWW; Cyber Security, Cyber crime in India, cyber attack, cyber warfare*

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### I. Introduction

The term security is a core concept for each and every part of life. In past, security analysis focused on state security, viewing it as a function of the different levels of threats which a state face from other state, as well as the working and effectiveness of state responses to such kind of threats[1]. The recent Information, Communication and Technology (ICT) revolution including the Internet, email, social websites, and satellite communications has revolutionized every aspect of human life, posing new challenges to national security [2].

It is an acceptable fact that for the globalized development of world, the ICT is essential for economic and social development, making a vital digital infrastructure upon which societies, governments and economies rely to perform their essential functions [1]. The open nature and working of the Internet guarantees that it is an unsafe environment for both public and private sector. As such, cyber security has come to encompass a wide range of issues such as critical infrastructure protection, cyber terrorism, cyber threats, privacy issues, cybercrime, and cyber warfare.

In the second decade of this century, cyber threats are evolving and increasing day by day. They are still initiated by some professional cyber criminals but also come from new sources, such as international states and organizations, and they may have motivations other than money making. These latter may include some types of “hacktivism” in the name of a political cause, political destabilization, cyber espionage, sabotage and even military operations[1]. The sophistication of cybercriminals, the emergence of cyber espionage, as well as the well-publicised activities of hacker collectives have combined to create the impression that cyber attacks are becoming more organised and that the degree of sophistication has increased significantly, showing clear signs of professionalization[2][3].

### II. Definition of Cyber Security

All incidents like Network outages, computer viruses, data conceded by hackers etc. affect our lives in ways that range from troublesome to life-threatening, as most government and financial institutions, military groups, corporations, hospitals, and other businesses store and process an abundant deal of confidential information on computers[1][4]. Thus, with the increasing volume and sophistication of cyber attacks, there is an increased need to protect personal information and sensitive business as well as to safeguard national security.



The term “cyber security” may refer to the collection and use of tools, policies, guidelines, training, actions, security concepts and safeguards, risk management approaches, assurance, and technologies that can be used to secure and protect the cyber environment as well as organization and user assets. In addition, cyber security aims to secure information technology and focuses on protecting computer programs, networks, and data, along with preventing access to information by unauthorized users as well as preventing unintended change or intended/unintended destruction[3][5].

### III. Cyber Security in India

In the Indian context, the issue of cyber security has received relatively little attention from policymakers, to the extent that the government has been unable to tackle the country’s growing needs for a robust cyber security apparatus.

As compared to other developed nations, cyber security projects and initiatives in India are far fewer in number.

There is utmost need to protect the most critical departments like satellites, finance, automated power grids, and thermal power plants from cyber attacks within country and outside the country. Indeed, the Indian government has admitted that there has been a large spike in cyber attacks against establishments such as the banking and financial services sector. Malicious activity on the Internet in India has ranged from small scale attack to large scale attacks.

In recent years a rapid growth has shown in number of cyber attacks in India. Total number as reported to and tracked by the Indian Computer Emergency Response Team (CERT-In) stands at 13.91 lakhs however fell in 2022[5]. In 2018 the total numbers of such incidents were 2,08,456 while in 2019 it was increased to 3,94,499 and in 2020 it was 11,58,208 and 14,02,809 in 2021[5]. Minister of State for Electronics and IT Rajeev Chandrasekhar said “With the borderless cyberspace coupled with anonymity, along with rapid growth of Internet, rise in cyber attacks and cyber security incidents is a global phenomenon and the government is fully cognizant and aware of various cyber security threats”[5].

The minister said that CERT-In operates an automated cyber threat exchange platform for proactively collecting, analyzing and sharing tailored alerts with organizations across sectors for proactive threat mitigation actions by them [5]. He further stated that government has published National Cyber Security Policy 2013 with the aim of building a more secure and better cyberspace for Indian citizens, businesses, and government, and the mission of protecting cyber infrastructure in cyberspace, creating capabilities to prevent and defend to cyber threats, reducing and minimizing damage from cyber attacks, through a combination of citizens, processes, institutional structures, technology, government and cooperation between all [5].

### IV. Who is affected by Cyber Crime?

As we can see each year, the number of cyber crimes reported across the country continues to increase at a significant pace. The nature of crimes, on the other hand, ranged from very small scale online frauds to lottery scams and sexual harassment. The sector most targeted though, seems to be the finance segment[5]. With the onset of the coronavirus pandemic, and most services moving to the online space, a higher risk extends to other sectors as well. The latest of these involved Big Basket, the online grocery platform with data of around 20 million users in November 2020[6].



Despite the private sector bearing the brunt of crime online, government agencies have also experienced the cyber attack. One such security breach was that involving India's unique citizen identification system- the Aadhaar, compromising extensive personal information like bank details, address and biometrics of over a billion Indians [6]. Also on 23rd November 2022, All India Institute of Medical Sciences (AIIMS), a premier public medical research institution and a hospital of Delhi, India, reported a cyber attack on its server. As a result of the attack, several patient care services, including registration of In-and-Out Patients, admission, billing, and discharge of patients, were inaccessible due to this severe cyber incident, and all day to day work of AIIMS comes to manual from automation. According to several news reports, this cyber incident was Ransomware in nature and disrupted the e-services of the AIIMS since 0700 hrs. on 23 November by 6th December 2022, AIIMS officials confirmed that the trial runs of the e-Hospital server were successful, and most of the lost data had been retrieved over the last few days[7].

## V. Steps taken by Government to handle Cyber Crime in India

1. **Banning of unsafe apps:** India had banned many apps (mostly of Chinese origin), which were found to be unsafe for usage by Indian citizens.
2. **The Indian Computer Emergency Response Team (CERT-In):** It operates as the national agency for tackling the country's cyber security, and has helped in lowering the rate of cyber attacks on government networks[6].
3. **Indian Cyber Crime Coordination Centre (I4C):** This Centre act as a nodal point in the fight against cybercrime to prevent misuse of cyber space for furthering the cause of extremist and terrorist groups[6].
4. **National Critical Information Infrastructure Protection Centre (NCIIPC):** It is a central government establishment, formed to protect critical information of India, which has an enormous impact on national security, economic growth, or public healthcare[6].
5. **Cyber Swachhta Kendra:** It helps users to keep their systems free of various viruses, bots/ malware, Trojans, etc[6]. It was launched in 2017.
6. **Cyber Surakshit Bharat:** It was launched by the Ministry of Electronics and Information Technology (MEITY) in 2018 with an aim to spread awareness about cybercrime and building capacity for safety measures for Chief Information Security Officers (CISOs) and frontline IT staff across all government departments[6].
7. **The Cyber Warrior Police Force:** It was organized on the lines of the Central Armed Police Force in 2018[6].
8. **Information Technology Act, 2000 (Amended in 2008):** It is the main law for dealing with cybercrime and digital commerce in India[6].
9. **BIS guidelines:** The broad guidelines for the identification, collection, acquisition and preservation of digital evidence issued by the Bureau of Indian Standards (BIS) is fairly comprehensive and easy to comprehend for all[6].
10. **Judicial Intervention:** a five-judge committee was constituted in July 2018 to frame the draft rules which could serve as a model for the reception of digital evidence by courts[6].



## VI. Challenges in dealing with Cyber Crime

One of the biggest challenges in war against cyber crimes is the lack of awareness on cyber hygiene. Even when crimes were reported to authorities, the infrastructure and process to tackle such cases were largely inefficient [7]. In some last years, the government of India works well in the cyber security direction and develop the Indian Cyber Crime Coordination Center to functioning investigations. On the other hand all Indians should know the importance of cyber security when they use internet, social media and means of cyber attack. They must be aware about the tools used for cyber security.

## VII. Conclusion

As the preceding pages make clear, cyber attacks targeting critical information infrastructures in India, such as energy, financial services, defense, health and telecommunications, have the potential of adversely impacting upon the nation's economy and public safety. From the perspective of national security, the securing of the critical information infrastructure has become a top priority, in line with policies already adopted by other digital nations. Indeed, the ever-growing interdependence of the digital sphere, across borders, has provoked the emergence of cyber security as a major component of national security strategies in states across the globe. India should not delay in following the rules and regulations and other means of cyber security.

## References

- [1] The Economic Times. (2014). "Government Mulls Digital India Programme to Connect All Villages." New Delhi, August 21, 2014.
- [2] <https://iasgateway.com/wp-content/uploads/2023/03/Daily-CA-04.03.2023-1-4.pdf>
- [3] <https://www.nextias.com/current-affairs/15-09-2021/pegasus-targeting-apple-devices>
- [4] <https://www.nextias.com/editorial-analysis/03-09-2022>
- [5] <https://vajiramas.com/article/indias-cyber-infrastructure-needs-more-thanpatches/63137f4b18c8e1556954adf6>
- [6] <https://ciso.economicstimes.indiatimes.com/news/number-of-cyber-attacks-steadily-rising-12-67-lakhduring-nov-2022/96244703>
- [7] <https://economicstimes.indiatimes.com/topic/CERTIn/2>



## Higher Consciousness in Shashi Deshpande Novels

Kamal Chandel

Banarsidas Chandiwala Institute of Information Technology, Delhi, India

kamal@bciit.ac.in

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**Abstract:** *Shashi Deshpande is an eminent writer of India who talks about the plight of Indian women deeply rooted in the male patriarchal culture with a different mode of perception in which a female gets the idea of her inner potential where she hopes to aspire to reach out to them, in the sense Shashi Deshpande heroine talks about how they feel within the confines of male patriarchal society but on a different note, they came up with their full potential after realizing their self-worth in due course of suffering, they aspire to be free to live and to reach out their higher goals and ambitions, it's through their constant realization of their inner potentials that they feel to go to with, all the confines of the male patriarchal society create a barrier for them to create a space for them, their realization paves the path for them to realize the higher consciousness which lies within them, this paper aims to bring about that state of consciousness.*

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### I. Introduction

The concern of Indian women's literature is the position of women in their community. The writings of women are therefore inclined to pay close attention to the multiple roles played by and expected of women. Their literatures reflect the complexities of it she has many relationships, in which they deal with, bring home the point that woman seldom, if ever, acts in isolation then how hard their lives can be, Being in a network of a mesh of relationships with others, here every action and ambition has a related consequence. Indian women writers have long pinpointed the fact that the woman is traditionally defamed in relation to others and most frequently, in relation to her men folk. Indian writers have consistently pinpointed the struggles of women who define themselves to have autonomy, while keeping with the family ties, customary and social values, and even to myths of womanhood. Most contemporary women writers have written about the women's individuality, attempting to give their women protagonists the power of self-definition but nobody has ever talked about how the woman achieves the higher state of consciousness in her life but in Shashi Deshpande novels, the main heroines achieve the higher consciousness and elevated state of being which is independent of any support from their men folk. However, at the same time, many women writers show their female protagonists as victims in their societies, seeming almost to equate the very position of women with that of victimhood and more so in a state of helplessness, Shashi Deshpande the Indian writer writing in English has shown the lonely and unique state of Indian females whose rights as individuals are actually axed by the orthodox society, to the point of suppressing them as such.

The orthodox society expects the females to be vassals, therefore, their self-identity and individuality are always sidelined and their psychology is also been defined by the male writers. Shashi Deshpande's feminism talks about emancipation and strong will of females not just legally but socially too. Ladies aren't likely to recuperate from their deprived state until they are socially acknowledged as human beings, Even the economically independent females find their lives torn as under between modernity and traditionalism. Being an Indian, Shashi Deshpande has poignantly and meticulously revealed the Indian social program and also the standard norms created for its females. She has portrayed the modern, educated; middle-class Indian females that would like to achieve their self-identity and higher state of consciousness and also restore the family ties of theirs. All her novels depict the female protagonists entangled in various complexities of marital life and relationships they pursue.

There is a continual desire in them to resolve and to achieve the higher state of consciousness.



## **II. Idea of Higher Consciousness**

Higher consciousness is quite amenable to correction and deep thought, however, if a person's self-assessment is lowered then in that situation it becomes impossible for that person to achieve the highest self and higher consciousness, this does not happen often, it has to pass the ordeal to win over the obstacle,

The person believes that he assumes himself to be quite adequate and does not want to bring about a change, without considering this as a necessity. It also happens that a self-assessment drops sharply after painful incidents or losses, but such a path can hardly be called suitable, in the novels of Shashi Deshpande the various female heroines are put into a very terrible situation and it is through this scenario they look within and introspect about their lives and in the last they come up with their new identity, their suppression makes them very strong in due course of their lives.

If a person realizes that he has got an overestimated self-assessment, then one would be able to look at himself critically, this is already a worthy start.

In order to achieve the higher consciousness one must change, one must evaluate himself or herself apart from that he or she must follow the process of self-assessment, one need to learn to notice all the good things taking place in one's life, one must Learn, to develop, to encourage oneself for success, and never act to the detriment of oneself, because such tactics do not bring worthy results. One must accept oneself as who you are, one must learn to talk about one's merits and shortcomings honestly at least to oneself, only then the process of self-assessment will become stable and healthy and it will result in achieving the higher state of consciousness.

## **III. Higher Consciousness in Shashi Deshpande Novels**

Shashi Deshpande portrays the new Indian woman with the plight of the contemporary Indian female, attempting to understand herself as well as to protect the identity of her as wife, mother and above all as human beings and all the female in her novels attempt to see the full potential within them and in due course of time, they strive to achieve the greater consciousness in the last, Shashi Deshpande has exposed the gross gender discrimination and the fallout of it in a male dominated society in her first novel *Roots and Shadows* (1983). In the novel, she depicts the agony and suffocation encountered by the protagonist Indu in a tradition bound and male-dominated society. The return to her natal home removed Indu from the course of her normal day-to-day life and put a physical distance between her and her husband for the first time. This affords Indu the opportunity to rethink her present life and her belief after her returning home, she came to the conclusion that she is capable of anything this is how she achieves higher consciousness in her life, Indu sees herself as a completely autonomous individual now she regarded herself with great honour, The novel includes various subplots exposing the complexities and ramification underlying the structure of her personal life.

The second novel *The Dark Holds No Terrors*, (1980) play a vital role too in bringing out the elevation of higher consciousness in the protagonist, (Sarita) Saru, she undergoes neglect and great humiliation as a kid and, after marriage, as a wife in due course of her life, Deshpande discusses the blatant gender discrimination shown by parents towards the daughters of theirs and the desire of theirs to have a male child.. After the marriage, Saru, gains a greater social status by becoming a medical doctor, At this point, everything starts to fall apart.

Her husband, who suffers an inferiority complex to the greater level, begins to abuse her sexually. Saru at this point in time feels unwanted and unloved. Earlier she fought against her mother who blamed her for the death (by drowning) of Dhruva, her younger brother, and later marrying Manohar, Saru is left to reflect on her motives for her life's choices, on her family lifestyle, on her relationships with others, and her professional identity and in the last she realizes her fullest





potential and achieves higher consciousness. Although Saru may have had a vague notion about returning to her old home and to her father to seek safety, sanctuary and support she eventually arrives at the understanding that she must confront rather than flee the terrors in her life and this is how she asserts herself fully in the novel.

The Binding Vine the next novel of her, deals with the private tragedy of the protagonist Urmil (Urmila) which focuses attention on the victims Mira and Kalpana. Urmil narrates the pathetic tale of Mira, her mother in-law, who's a target of marital rape. Mira, in the solitude of the unhappy marriage of her, would create poems based upon her insights, which were posthumously translated and released by Urmil, Urmil also narrates the tale of her acquaintance Shakutai, that had been deserted by the husband of her for another female. The toughest part of her tale is actually that Shakutai's elder daughter Kalpana who is brutally raped by Prabhakar, her daughter Sulu's husband.

Urmil takes up courage on Kalpana's behalf and brings the culprit to book. In the process of understanding other women and empathising with them she came to realize that women are worth more than being in familial ties she achieves higher consciousness in the final plot of the novel, Urmil finds her own way of coping with grief of losing her child. The tales of various other women are also recounted, adding to the tapestry of the lives who rise above the confines and achieve greater and higher consciousness, which touched Urmil.

Deshpande's heroines are uncomfortably, even fearfully, aware that they have defined themselves and achieved higher consciousness in relation to their husbands after resolutely cutting off even family ties to avoid being defined in relation to their families. This idea is put forth through the main character in Roots and Shadows-"But twice in my life I had thought that I was free...Both times I found out how wrong I was. New bonds replace the old to achieve the higher consciousness in life. That is all. These women eventually realize that they have simply avoided one trap only to fall into another, and this other is a trap so insidious that for all their education and intelligence, they had not managed to avoid being victims of it.

The novel, that long silence also talks about the idea of the higher state of consciousness in Jaya life, the wife of a teacher Mohan, in the beginning, of her life she has been shown as a very submissive wife, always dependent upon the instruction so her husband Mohan, although she was very creative since childhood, but when she goes to the dadar apartment with her husband Mohan, she sits calmly and contemplates about her state of mind, about her unheard and unspoken state, she talks to herself and in the last, she realizes her worth, her husband Mohan always tried to confine her to the four walls of the room, not allowing her creative talent of creativity to come out fully, he never appreciated her for her talent, she felt suffocated in her life but after the contemplation and reconsiderations of her life, she realizes that she is talented and she shows her creative writing to kamat who comes in her neighborhood to live, though he was an artist, he appreciated all her creative talent at this spot when Jaya shows her writings to him, she felt that she should rise above the narrow confines of male patriarchal society and she should assert her own individuality and this is how she achieved higher state of consciousness in due course of her life.

#### IV. Conclusion

It can be concluded that the selected novels of Shashi Deshpande namely that long Silence, Root and the shadow, The dark hold no terror, The binding wine talks about the elevation of higher consciousness, in all these novels the heroines realize their fullest potential and aspire to pursue those ideal in spite of great difficulties this realization marks the transition in their lives.



## References

- [1] P. Rajya Lakshmi, Dr. N. Arvinda (2017). "Feminism In Shashi Deshpande's Novels" Research Journal of English Language and Literature (RJELAL) Vol.5.Issue 3. 2017 (July-Sept) pp. 164-166
- [2] Sarla Palkar(1991). 'Breaking the Silence: Shashi Deshpande's That Long Silence,' Indian Women Novelists ed. R.K.Dhawan Set. 1, Vol. V. (New Delhi: Prestige Books, 1991), pp. 169-175.
- [3] K.M. Pandey (2001). Dimensional Depth of Female Consciousness: Shashi Deshpande's the Binding Vine (New Delhi: Atlantic Publishers & Distributors, 2001), pp. 74-76.
- [4] N. Krishnaswamy, John Varghese and Sunita Mishra(2001). Contemporary Literary Theory: A Student's Companion (New Delhi: Macmillan, 2001)



## IoT and its Applications

Anu Taneja

Banarsidas Chandiwala Institute of Information Technology, Delhi, India

[anutaneja@bciit.ac.in](mailto:anutaneja@bciit.ac.in)

**Abstract:** Internet of Things (IoT) is an emerging field that eases the task of user varying from simple to complex tasks. With the advancements in technology, IoT has extensive applications in daily life of human beings. This paper discusses briefly about the architecture and application areas of IoT. It also discusses how IoT has evolved along with its applicability in India. In addition to various benefits, this paper also discussed about the challenges faced in this field. This paper also highlights the future work that can be accomplished in this field that would benefit the researchers and academicians working in this domain.

**Keywords:** analytics; energy, sensors; smart cities; real-time

### I. Introduction

IoT stands for the "Internet of Things." It is a network of physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, and connectivity that enable these objects to collect and exchange data [3]. The data collected by these devices can be used to improve efficiency, reduce costs, and enhance user experiences in various industries, such as manufacturing, transportation, healthcare, and agriculture.

IoT is powered by the advancements in wireless communication technologies, miniaturization of sensors, and cloud computing. These technologies enable devices to collect and transmit data to the cloud, where it can be analyzed, processed, and acted upon in real-time. IoT applications can range from simple tasks, such as turning on and off lights remotely, to complex tasks, such as predicting equipment failures in a factory or monitoring patient health in a hospital.

The potential of IoT is vast, and it is predicted that by 2025, there will be more than 75 billion IoT devices worldwide, generating trillions of dollars in revenue. However, with the growth of IoT, there are also concerns about data security, privacy, and the ethical implications of collecting and using personal data.

### II. History of IoT

The history of IoT dates back to the early 1980s, when researchers at Carnegie Mellon University developed a Coke machine that was connected to the internet. The machine was able to report its inventory and whether the drinks were cold or not, allowing users to check before making a trip to the machine.

In the 1990s, the term "Internet of Things" was first coined by Kevin Ashton, a British technology pioneer. He used the term to describe a system where everyday objects could be connected to the internet and communicate with each other [2].

The first wave of IoT devices came in the early 2000s with the development of RFID (Radio Frequency Identification) technology, which enabled objects to be tracked and identified wirelessly. This technology was primarily used in supply chain management and asset tracking applications.

The next wave of IoT development came with the proliferation of smartphones and wireless networks, which enabled the development of low-cost, low-power sensors and devices that could be connected to the internet.

Today, IoT is a rapidly growing industry, with an estimated 31 billion devices connected to the internet as of 2021. The development of 5G networks is expected to accelerate the growth of IoT, enabling faster and more reliable connections between devices and the cloud.



### III. Architecture of IoT

The architecture of IoT refers to the way in which IoT devices, networks, and platforms are designed and connected. While there are many variations in IoT architecture, most systems include the following components [1]:

- **Sensors and Actuators:** These are the physical devices that collect data from the environment and act on it. Sensors can include temperature sensors, humidity sensors, motion sensors, and more, while actuators can include motors, switches, and other devices that can act on the environment.
- **Connectivity:** IoT devices need to be connected to the internet to communicate with other devices and platforms. This can be achieved through a range of wireless and wired technologies, such as Wi-Fi, Bluetooth, Zigbee, and cellular networks.
- **Gateways:** Gateways are devices that connect IoT devices to the internet and other networks. They can perform tasks such as data aggregation, filtering, and protocol translation.
- **Cloud Platforms:** IoT data is typically processed and analyzed in the cloud, using cloud platforms such as Amazon Web Services (AWS), Microsoft Azure, or Google Cloud. Cloud platforms provide the infrastructure and tools for processing and analyzing large amounts of data.
- **Analytics and Applications:** IoT data is processed and analyzed to extract insights and enable new applications. This can include machine learning algorithms, predictive analytics, and real-time decision-making systems.

Overall, the architecture of IoT is designed to enable the collection and analysis of large amounts of data from physical devices and environments, and to enable new applications and services that improve efficiency and enable new possibilities.

### IV. Applications of IoT

IoT has a wide range of applications across various industries. Some of the most common applications of IoT are [5]:

- **Smart Homes:** IoT devices can be used to control and automate home appliances such as lighting, heating, air conditioning, and security systems.
- **Healthcare:** IoT devices can be used to monitor patient health, track medication usage, and even provide remote medical consultations.
- **Manufacturing:** IoT devices can be used to monitor equipment performance, optimize production processes, and even predict equipment failures.
- **Agriculture:** IoT devices can be used to monitor soil conditions, weather patterns, and crop growth, allowing farmers to optimize their yields and reduce waste.
- **Transportation:** IoT devices can be used to track vehicles, monitor driver behavior, and optimize logistics and supply chain operations.
- **Energy:** IoT devices can be used to monitor energy consumption, optimize energy usage, and even enable smart grids and renewable energy solutions.
- **Retail:** IoT devices can be used to track inventory levels, optimize supply chain operations, and provide personalized customer experiences.
- **Smart Cities:** IoT devices can be used to monitor and manage traffic, improve public safety, and optimize energy usage in cities.



These are just a few examples of the many applications of IoT. As the technology continues to evolve, it is expected that we will see even more innovative applications of IoT in the future.

## V. IoT in India

IoT is gaining momentum in India, with both government and private sectors investing in its development and deployment. The government's 'Smart Cities' initiative is one of the key drivers of IoT in India, with the aim of creating modern and sustainable cities through the use of technology [4].

There are many IoT startups and companies in India, working on developing and deploying IoT solutions in areas such as agriculture, healthcare, transportation, and energy management. For example, IoT-enabled agricultural solutions can help farmers monitor crop health and optimize irrigation, while IoT-based healthcare solutions can improve patient monitoring and reduce healthcare costs.

In addition, the Indian government has launched several initiatives to support the development of IoT in the country, such as the National IoT Policy and the IoT Center of Excellence. These initiatives aim to create an enabling environment for the growth of IoT startups and companies, and to promote innovation and entrepreneurship in the field.

However, there are also challenges that need to be addressed for the widespread adoption of IoT in India. These include issues such as connectivity, infrastructure, and digital literacy. Nevertheless, the potential benefits of IoT in India are significant, and with the right support and investment, it is likely to have a transformative impact on many areas of the economy and society.

## VI. Challenges in IoT

While IoT has immense potential, there are also several challenges that need to be addressed for its widespread adoption. Some of the key challenges of IoT include [2, 3]:

- **Security:** As more and more devices are connected to the internet, the potential for security breaches and cyber attacks increases. IoT devices can be vulnerable to hacking, and if compromised, can be used to launch attacks on other devices or networks.
- **Privacy:** IoT devices collect a lot of data, much of which can be sensitive or personal. There are concerns about who has access to this data and how it is being used. There is a need for stronger data privacy laws and regulations to protect users' personal information.
- **Interoperability:** With so many different devices and platforms, there is a need for standards and protocols to ensure that devices can communicate with each other seamlessly. This is important for ensuring that devices from different manufacturers can work together and be integrated into larger systems.
- **Complexity:** IoT systems can be complex, with many different devices, sensors, and platforms involved. There is a need for better tools and platforms to simplify the development and deployment of IoT applications.
- **Power Consumption:** Many IoT devices are designed to run on low-power, but this can make them vulnerable to power failures, and limit their functionality. There is a need for more efficient power management and energy harvesting techniques to ensure that IoT devices can operate effectively.
- **Data Management:** With the vast amounts of data generated by IoT devices, there is a need for effective data management strategies to ensure that data is processed, analyzed,



and stored efficiently.

Addressing these challenges will be critical to the success of IoT in the future. As the technology continues to evolve, there will likely be new challenges to overcome as well.

## VII. Conclusion and Future Work

In summary, the Internet of Things (IoT) refers to a network of physical devices, vehicles, home appliances, and other items that are connected to the internet and can communicate with each other. IoT has a wide range of applications in areas such as smart homes, healthcare, transportation, agriculture, and manufacturing.

However, there are several challenges that need to be addressed for the widespread adoption of IoT. These include security, privacy, interoperability, complexity, power consumption, and data management.

Future work in IoT will focus on improving security measures, integrating artificial intelligence and edge computing, standardizing protocols and technologies, developing more energy-efficient and sustainable devices and systems, and protecting user privacy. As IoT continues to evolve, it is likely to have a significant impact on society, enabling new applications and improving efficiency in many areas of our lives.

IoT is a rapidly evolving field, and there are many areas where future work is needed to improve the technology and its applications. Some of the key areas of future work in IoT include:

- **Security:** As the number of IoT devices continues to grow, the need for better security measures becomes more urgent. Future work will focus on developing new security protocols and technologies to prevent cyber attacks and ensure the privacy and security of user data.
- **Artificial Intelligence:** IoT devices generate vast amounts of data, and artificial intelligence (AI) can be used to process and analyze this data to identify patterns and insights. Future work will focus on integrating AI into IoT systems to improve efficiency and enable new applications.
- **Edge Computing:** Edge computing involves processing data closer to the source, rather than sending it to the cloud for processing. This can improve response times and reduce bandwidth requirements. Future work will focus on developing new edge computing technologies to enable more efficient and effective IoT applications.
- **Standardization:** With so many different devices and platforms involved in IoT, standardization is crucial for ensuring interoperability and compatibility. Future work will focus on developing new standards and protocols to enable seamless communication between devices and platforms.
- **Sustainability:** IoT devices can consume a lot of energy, which can be a concern for sustainability. Future work will focus on developing more energy-efficient devices and systems, and exploring new energy harvesting techniques to power IoT devices.
- **Privacy:** As IoT devices collect more and more data, there is a growing need to protect users' privacy. Future work will focus on developing new privacy-enhancing technologies and policies to protect user data and ensure that IoT devices are used ethically.

Overall, future work in IoT will focus on improving the security, efficiency, and sustainability of IoT devices and systems, while also ensuring that they are used ethically and in ways that benefit society as a whole.





## References

- [1] Keramidas, G., Voros, N., & Hübner, M. (2016). *Components and services for IoT platforms*. Cham: Springer International Pu.
- [2] Al-Turjman, F. (Ed.). (2019). *Artificial intelligence in IoT*. Springer.
- [3] Adryan, B., Obermaier, D., & Fremantle, P. (2017). *The technical foundations of IoT*. Artech House.
- [4] Holler, J., Tsiatsis, V., Mulligan, C., Karnouskos, S., Avesand, S., & Boyle, D. (2014). *Internet of things*. Academic Press.
- [5] Kocovic, P., Behringer, R., Ramachandran, M., & Mihajlovic, R. (Eds.). (2017). *Emerging trends and applications of the internet of things*.



## Security Techniques using Enhancement of AES Encryption

Meetender

Banarsidas Chandiwala Institute of Information & Technology, Delhi, India

[mitenderadhana3@gmail.com](mailto:mitenderadhana3@gmail.com)

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**Abstract:** *Advanced Encryption Standard algorithm is used for Security over network. It uses static s-box by default. we proposed a method in which data is divide into Tokenization and then uses Dynamic s-box by using xor of original s-box and 1's compliment of s-box for AES Encryption . Huffman Encoding and Biometric Scheme are also used for Enhancement of the security of the AES Techniques*

**Keywords:** AES, AES Enhancement, Advanced Encryption Standard, Encryption, Security

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### I. Introduction

The rapidly developing assortment of remote correspondence clients has prompted expanding interest for safety efforts and gadgets to protect client data transmitted over remote channels. Two sorts of crypto legitimate frameworks have been produced for that reason symmetric and awry cryptosystems. Symmetric cryptography like inside the Data Encryption Standard, 3DES and Advanced Encryption Standard (AES), utilize a similar key for the sender and collector, each to encode the first message and unscramble message figure content. Deviated cryptography, as inside the Rivest-Shamir-Adleman (RSA) utilizes totally unique keys for encoding and deciphering, disposing of the key trade disadvantage. Symmetric cryptography is more suitable for the encoding of an outsized measure of data. The AES calculation sketched out by the National Institute of Standards and Technology in US has been broadly acknowledged to switch DES in light of the fact that the new symmetric encryption calculation. The AES calculation could be a symmetric square figure that procedures information pieces of 128 bits utilizing a figure key of length 128, 192, or 256 bits. Each datum square contains a 4×4 exhibit of bytes called as the state, on that the AES calculation is connected. The proposed calculation contrasts from standard AES in light of the fact that it has 200 bits piece size and key size each. Number of rounds is steady and up to 10 in this calculation. The age of key development and substitution enclose are done a comparative technique as in standard AES piece figure. AES has 10, 12 and 14 rounds for 128-bit keys, 192-bit keys and 256-bit keys separately.

### II. Proposed Work

#### 2.1 AES Algorithm

AES algorithm uses 10, 12, 14 rounds of function that depends upon the size of the key. Each rounds consists of four functions, if AES contains n rounds then n-1 rounds contains all the 4 operations, but n rounds uses only 3 rounds in encryption as well as decryption. In Encryption step, n round does not contain mix columns rounds. The block diagram of AES is:

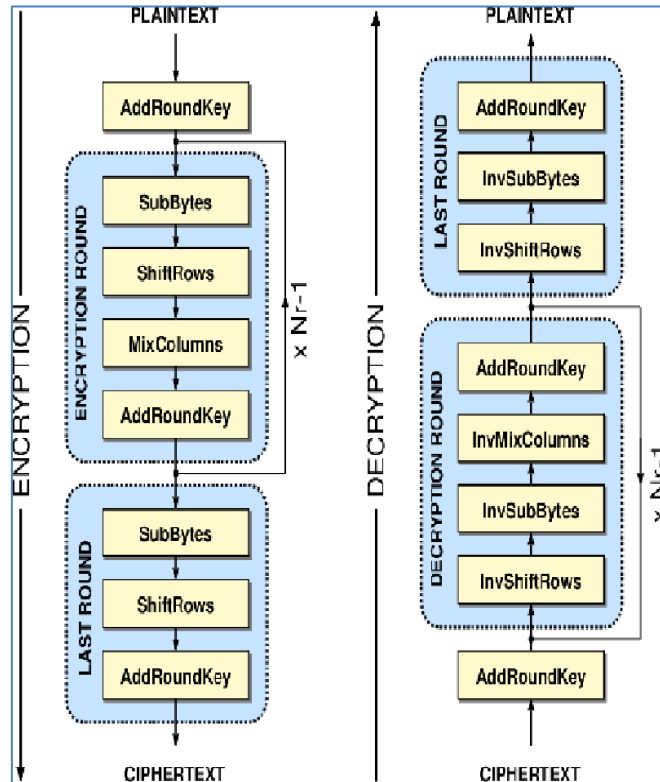


Fig 1. Block Diagram of AES

Table1. Relationship between Keys and No. of Rounds

Keys	No. of Rounds
128	10
192	12
256	14

Each Round of Encryption consists of 4 operations which are:

1. Sub Bytes
2. Shift Rows
3. Mix Columns
4. Add Round Key

Each round of decryption consists of 4 operations which are:

1. Inverse Shift Rows
2. Inverse Sub Bytes
3. Add Round Key
4. Inverse Mix Columns.

**A) Sub Bytes**

The first step is Sub Bytes, in this, we substitute the value of matrix with substitution box, there is entry in substitution box for each byte. The Inverse operation is known as inverse Sub Bytes which is used in Decryption step.

**B) Shift Rows**

Second function is Shift Rows, as name suggests we shift the rows in matrix toward left in circular manner. The first row will remain same in new matrix. The second Row will be shift by 1, third row will be shifted by 2 and last row will be shifted by 3. The reverse operation is known as inverse Shift Rows.

**C) Mix Column**

The 3rd operation is Mix columns, as name suggests in this step we mix the column. We multiply the give state matrix with fix matrix and the output then act as input to the next operation. The inverse operation of mix column is inverse mix column operation and there is different matrix which is used in reverse operation.

**D) AddRoundKey**

The Final operation of single round of AES is called AddRoundKey. In initial 3 operations we did not use any keys so that operations can be reversible without knowledge of keys, so security is very less in that 3 steps. In AddRoundKey step, we do the XOR operations of state table with the matrix of 4\*4 of keys. If there are n rounds in AES operation, then there will be n+1 AddRoundKey. We do AddRoundKey before any round which provides more security. The Key matrix is given by the key Distribution system.

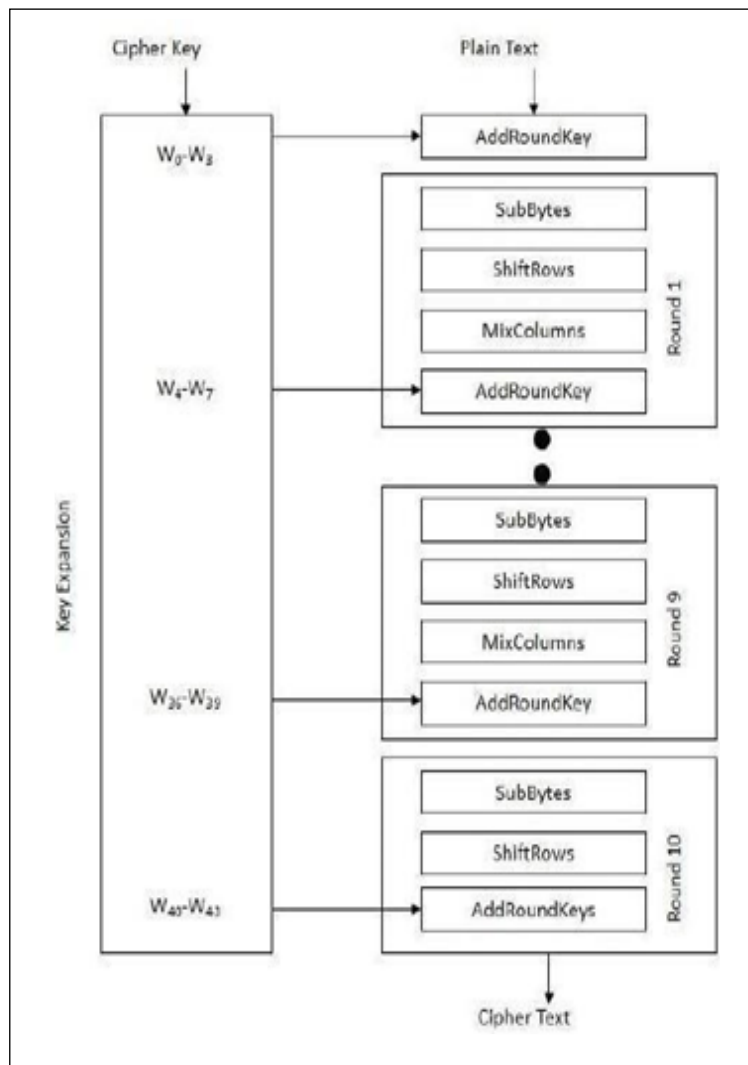


Fig 2. AES Encryption Process



### III. Data Security with Tokenization

Tokenization is an innovation which replaces the touchy information field with a surrogate esteem called a token. This aids in shielding touchy information from information rupture. The surrogate esteem i.e. token typically resembles the first information regarding position, length and so on. Typically a capacity or database is utilized to see the first information utilizing token. Token can be produced in two ways – (a) the first information can be created utilizing token (b) the first information can't be created utilizing token.

Tokenization can upgrade the assurance of delicate information by offering token-based information substitution esteem for plain-content touchy information components. At the end of the day, rather than keeping up cipher text and a related key (ID) inside the Organization's information stores, a solitary token is put away and utilized as a pointer to the scrambled an incentive in the vault. In managing an account framework, a charge card number, for instance, is supplanted inside the shipper's stock piling condition by a token esteem created such that it can't be connected back to the first information component. A safe cross-reference table is built up to permit approved query of the first esteem, utilizing the token as the record. Encryption instruments and secure key administration supplements this approach by ensuring the first incentive inside this condition. To any individual who doesn't have approval to get to the vault, the token esteem is absolutely aimless; it's quite recently arbitrary characters. The proposed Work Plan in tokenization is explained as below:

**1. Identification of Sensitive Data:** ID of delicate information is the sole obligation of the cloud shopper. There are diverse sorts of information regarding secrecy, protection or affectability. Ordinarily every one of the information of an association is not 100% delicate to protection and classification. Before outsourcing information by cloud purchaser, it is conceivable to distinguish level of classification of their information. In some Government Organizations, SSN- “Standardized savings Number” of the worker is exceptionally classified as exposure of such characteristic is not fancy by the representative or the Government don't prescribed to make such trait open. Another quality in particular, “Telephone” is to some degree delicate as the majority of the workers won't yearn to reach number open. Nonetheless, the rest of the qualities, for example, “Worker Code”, “Name”, “Assignment” “Address” and so forth are not all that touchy contrast with other attributes. Even the “Representative's name is exceptionally private”. Therefore, this is upto the manager of the association to characterize the sorts of information as far as classification, affectability or security.

**2. Segregation of Highly Confidential Data:** In the wake of breaking down information of the association, the information chairman can characterize levels of privacy which can be connected to the association's information. At that point, the distinguished information can be mapped with the characterized level of confidentialities Different security instruments, for example, encryption, tokenization and so forth could be chosen for each level of information. At that point, information with very secret will be isolated with certain connecting component for information tokenization. Assume, the System Administrator characterizes three levels of classification and same is connected to the distinguished information of table at Fig. 1, the accompanying table demonstrates the move to be made up for information assurance. At that point, the accompanying table containing “SSN” will be isolated.

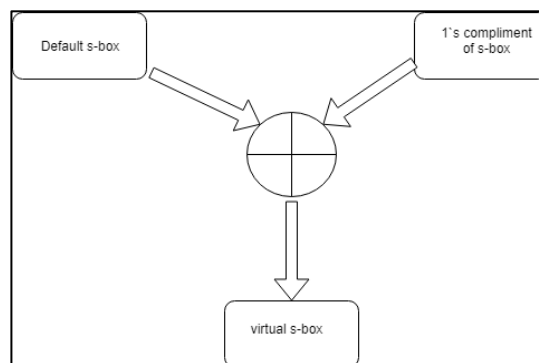
**Table 3: Level of Fields/ Column Action to be taken for information:**

Confidentiality	Type of Protection
SSN	Tokenization
Phone	Encryption
Name, Designation, Address	No protection

**3. Security Care of Sensitive Data:** Once the information recognizable proof and isolation of exceedingly secret information is finished, the following obligation is safety efforts to be connected on the information of the association. At the same time, the information executive can choose one of the accessible calculations to encode the information whichever is important and tokenize the exceedingly touchy information. The tokenize information i.e. the surrogate esteems will supplant the first information. In first CSP condition, just the surrogate estimations of exceedingly secret information are accessible alongside related data. On the off chance that some person takes the information or break the information, the first information won't touch, just the surrogate, stunning esteems will be influenced. In second CSP condition, there is no genuine significance of exceptionally private information as the information is not related with other applicable data.

Now we will use encoding on the selected data to compress it so we will use Huffman Encoding here. Information weight acknowledges a fundamental part in PC structures. To transmit information to its goal speedier, it is fundamental to either build the information rate of the transmission media or basically send less information. The information weight is utilized as a bit of PC structures. To make the PC sorts out snappier, we have two alternatives i.e. one is to by one means or another improvement the information rate of transmission or some way or another send the less information. In any case, it doesn't gather that less data ought to be sent or transmitted. Data must be done at any cost. The output of the Huffman Encoding will be in compressed form. Now it will work as an input to the AES Encryption process here. The further steps are mention below

- Take the original s- box and find its 1`s compliment.
- Then perform the XOR operation between original S- box and 1`s compliments of S- box
- The output will be come as virtual s-box which will be used here for encryption process
- The reverse process will takes place for decryption process:



**Fig 3. Virtual S-box Implementation**



e) At the end, we can also use the biometric security for encryption and decryption process:

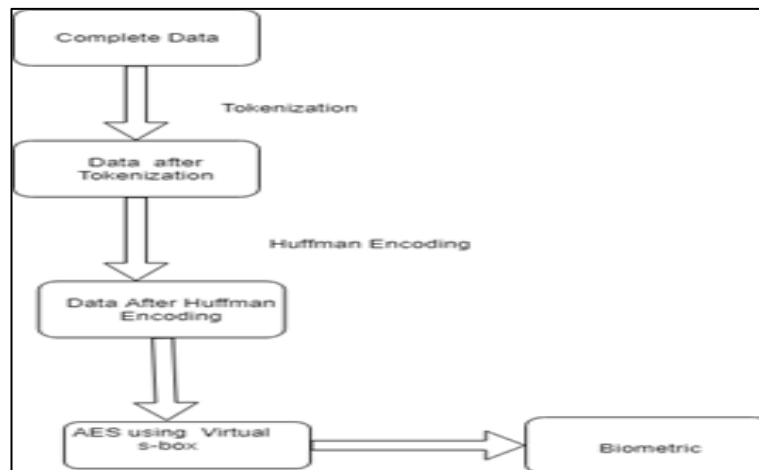


Fig 4. Flow Diagram of Proposed Method

#### IV. Conclusion

The proposed AES calculation with crossover approach will be a successful procedure for giving solid security in message transmission by adding greater many-sided quality in AES to build Confusion and Diffusion in Cipher content. It will shield message from Brute-force Attack, Differential Attack, Algebraic Attack and Linear Attack. Proposed framework will be a compelling strategy for the applications which depend on web, for example, web based business internet shopping, Stock Trading, Net Banking and Electronic bill instalment etc. Arithmetic Encryption and biometric techniques will enhance the security but it will increase the cost as well as time.

#### References

- [1] G. Singh and Supriya, "A study of encryption algorithms (RSA, DES, 3DES and AES) for information security," *International Journal of Computer Applications*, vol.67, pp. 33-38, April 2013.
- [2] P. S. Mukesh, M. S. Pandya and S. Pathak, "Enhancing AES algorithm with arithmetic coding," 2013 International Conference on Green Computing, Communication and Conservation of Energy (ICGCE), pp. 83-86, IEEE, 2013.
- [3] P. Mahajan and A. Sachdeva, "A study of Encryption algorithms AES, DES and RSA for security," *Global Journal of Computer Science and Technology*, vol.13, pp. 14-22, 2013.
- [4] B. Padmavathi and S. R. Kumari, "A Survey on Performance Analysis of DES, AES and RSA Algorithm along with LSB Substitution," *International Journal of Science and Research (IJSR)*, vol.2, pp. 170- 174, April 2013.
- [5] Z. Musliyana, T. Y. Arif and R. Munadi, "Security Enhancement of Advanced Encryption Standard (AES) using Time-Based Dynamic Key Generation," *ARNP Journal of Engineering and Applied Sciences*, vol.10, pp. 8347-8350, October 2015.
- [6] J. Juremi, R. Mahmud and S. Sulaiman, "A proposal for improving AES S-box with rotation and key-dependent," *International Conference on Cyber Security, Cyber Warfare and Digital Forensic (CyberSec)*, pp. 38- 42, IEEE, 2012.
- [7] A. Janadi and D. A. Tarah, "AES immunity Enhancement against algebraic attacks by using dynamic S-Boxes," 3rd International Conference on Information and Communication Technologies: From Theory to Applications (ICTTA), pp. 1-6, IEEE, 2008.
- [8] S. Sahmoud, W. Elmasry and S. Abudalfa, "Enhancement the Security of AES Against Modern Attacks by Using Variable Key Block Cipher," *International Arab Journal of e-Technology*, vol.3, pp. 17-26, January 2013.
- [9] "Encryption and Decryption," [Online] Available: [https://developer.mozilla.org/en-US/docs/Archive/Security/Encryption\\_and\\_Decryption](https://developer.mozilla.org/en-US/docs/Archive/Security/Encryption_and_Decryption) [Accessed on December 28, 2016].