High Speed Data Cryptography Technique of Blowfish Algorithm using VHDL

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Abstract—Nowadays, information security is more important issue for reliable data transfer. A cryptographic method is widely used to ensure the security of data. To keep the information from being hacked by the other party, data is encoded by using this method. To meet these requirements the implementation of the Blowfish algorithm in the commercial FPGA has can be used to obtain high performance of such FPGA based reconfigurable systems. This paper presents, how such a system can be used to enhance the speed of cryptographic computation. By using FPGA design, the Blowfish computation can be increased in speed. In this, Xilinx software is used for the analysis purpose. The results will lead to the general conclusion that the use of an FPGA coprocessor is ideally suited for the execution of cryptographic algorithms regarding execution time and flexible usage. The performance is analyzed in terms of its architecture, speed, throughput, and encryption time.

Keywords- Blowfish algorithm, FPGA processor, VHDL design.

I. INTRODUCTION

Cryptography is a way of protecting the information by transforming it into an unreadable format known as cipher text. Plain text is converted into cipher text using encryption key. Only the person who possess the secret key can decipher the message into the original form. The information looks like hidden inside the image or the text file. The encryption key is used to encrypt the data. This encrypted information is then transmitted to the particular receiver. At the receiver end, cipher text is converted back into plain text using description key. Receiver extracts the original information from the image or a text with the help of a public key provided by the transmitter. So even if any unwanted person gets the data with information content hidden in it, it cannot be extracted without appropriate public key.

There are two types of encryption algorithms: symmetric key encryption algorithm and asymmetric key encryption algorithm. Symmetric key encryption algorithm or private key encryption uses same key for encryption and decryption. Security. While the asymmetric encryption algorithm or public key encryption uses two different keys for encryption and decryption. Blowfish algorithm is symmetric encryption algorithm. Blowfish algorithm has simple structure and it can perform encryption and decryption process quickly. There are two ways to implement the cryptographic algorithms via software or hardware implementation. One type of hardware implementation is using FPGA. FPGA or Field Programmable Gate Arrays can be programmed or configured by the user or designer after manufacturing and during implementation. Hence they are also known as On-Site programmable. Unlike a Programmable Array Logic (PAL) or other programmable device, their structure is similar to that of a gate-array or an ASIC. Thus, they are used to rapidly prototype ASICs, or as a substitute for places where an ASIC will eventually be used. The programming of the FPGA is done using a source code using a Hardware Description Language (HDL) to specify how the chip should work. VHDL language is used for implementation on FPGA. FPGA is widely used because of several reasons, it is cheap, easy to implement, reprogrammable, has high speed and good level of security.

II. LITERATURE REVIEW

Various authors made a research on the implementation and modifications of blowfish algorithm for efficient results.

1) Kurniawan Nur Prasetyo, Yudha Purwanto, Denny Darlis 2014

This paper presents blowfish algorithm is implemented on FPGA using VHDL programming language. The testing showed that blowfish algorithm gave a good performance when implemented in FPGA. This research also presents the performance of blowfish algorithm with total time taken for
encryption. The result shows that reducing the total encryption
time, give greater throughput and not affect avalanche effect
significantly [1].

2) Amaal A. Abd El-Sadek, Talaat A. El-Garf, Mohammed M. Fouad 2014

This paper presents the high quality speech coding algorithm
which has been standardized by ITU-T with low bit rate. This
algorithm is based on a conjugate structure algebraic coding
scheme. This paper proposes a new method for generating
S-boxes and P-arrays. This new generating method leads to a
reduction in time complexity of generating S-boxes and P-
arrays. The results showed that the modified design of the
algorithm offers the same level of security as the original
blowfish cipher with a less complexity [2].

3) Metaliya Viral, Deepak Kumar Jain, Sardhara Ravin 2014

This paper uses video cryptography is used for secure
transmission of data. It uses pixel mapping for the encryption
of the images which are the basic building blocks of any video
file. Any video is a combination of different frames and all the
frames has fixed frame rate. The video is distributed into the
photo frames using a matlab code then all the frames are
sequentially stored. Each such frame contains a combination
of red, blue and green layers. After the completion of the pixel
mapping, all the images are placed in a sequential manner and
then all the frames are cascaded for generation of the original
video file with encryption. This new video is almost same as
that of original video with no changes visible to the naked eye
[3].

4) Viney Pal Bansal, Sandeep Singh 2015

This paper uses hybrid technique which is implemented using
VHDL coding. The Xilinx ISE 14.1 is used for synthesis
purpose. It uses hybrid RSA and blowfish encryption
technique which is implemented by VHDL. This hybrid
technique has both symmetric and asymmetric properties.
Thus, the algorithm provides better security for cloud computing. Also hybrid algorithm is successfully implemented
by using VHDL. [4]

. 5) Sudeshna Bora, Pritam Sen, Chittaranjan Pradhan 2015

This paper uses an image encryption scheme used to protect
different types of images. In this algorithm, the blowfish and
cross chaos are combined to form double encryption
algorithm. The designed scheme secures the color image. For
decryption, original images are obtained using the same key
and by applying the same cross chaos parameters that were
used during the time of encryption. Simulation and analysis
results tells that the Blowfish algorithm is able to protect
different types of images with a high security [5].

6) Rafidah Ahmad, Asrulnizam Abd. Manaf 2016

This paper presents a development of an improved power
throughput using blowfish algorithm based on field
programmable gate array (FPGA).The performance is
analysed in terms of its speed, throughput, and power. Results
show that the proposed Blowfish reduces time and increases
throughput at low power consumption [6].

7) Nusrat Jahan Oishi, Md.Arafin Mahamud, Asaduzzaman

2016

This paper presents, a hybrid form algorithm of Blowfish and
Rivest Cipher 6 (RC6) which is used which solves the security
problems of blowfish and maintains the efficiency of
blowfish. Thus, it is able to use in place of AES. The usage
of one S-Box by overlapping process eliminates the collision
attack of blowfish algorithm. Sub key generation process
removes the Brute Force attack. It enhances the performance
of Blowfish algorithm by using a function of RC6. The
proposed algorithm takes less encryption-decryption time and
thus increases speed of system [7].

8) Kapil Earanky, Haytham Elmiligi, Musfiq Rahman

This paper present a CUDA (Compute Unified Device
Architecture) implementation of the blowfish algorithm. It has
been designed to make use of the unified memory model. Result
 tells that the unified implementation of the
blowfish algorithm performs better than an efficient CPU
implementation and performs better than a non-unified
CUDA implementation of the algorithm. Using (CUDA)
design, the paper describes the implementation and
performance enhancement of the blowfish block cipher
algorithm [8].

III. PROPOSED WORK

Blowfish algorithm was designed in 1993 by Bruce Schneier
as a fast, reliable encryption algorithm. Blowfish is a variable-
length key, 64-bit block cipher. The algorithm consists of two
parts: a key-expansion part and data- encryption part. Key
expansion converts a key of at most 448 bits into several
arrays of 4168 bytes. Data encryption occurs via a 16-round
Feistel network. Where each round consists of a key
dependent permutation and data-dependent substitution. All
operations are XORs and then added on 32-bit words. A
Feistel network is a general method of transforming any
function (usually called an F function) into a permutation.
Every round consist of a key and data dependent substitution
and a key dependent permutation. The algorithm works as
follows:

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**Encryption:**

Blowfish has 16 rounds.

The input is a 64-bit data element, x.

Divide x into two 32-bit halves: xL, xR.

Then, for i = 1 to 16:

- xL = xL XOR Pi
- xR = F(xL) XOR xR
- Swap xL and xR

After the sixteenth round, swap xL and xR again to undo the last swap.

Then, xR = xR XOR P17 and xL = xL XOR P18.

Finally, recombine xL and xR to get the ciphertext.

**Description**

Initially the input is given to the MATLAB simulink. The data can be a text or image. If the data is image then it is converted from 1D to 2D by means of matlab. This binary sequence is then given to FPGA which do the programming using VHDL in Xilinx. Then this data is again converted back into original form and at the end output is taken.

Pre-processing is used because FPGA takes the input in binary form only. In this, the input image is converted from RGB to Gray and then by using A to D convertor it is converted to binary form. This binary data is given to FPGA. After applying blowfish algorithm, the data is transmitted for Post processing where the binary image is converted from Gray to RGB form. Finally, the encrypted image is taken at the output.

For coding purpose VHDL is used. The VHDL Hardware Description Language is a formal notation intended for use in all phases of the creation of electronic systems. Because it is both machine readable and human readable, it supports verification, synthesis, and testing of hardware designs. The digital system may be a simple logic gate or it may be a complete electronic system.

**IV. CONCLUSIONS**

Hacking attacks are complex which causes serious problem on Internet. There are numerous ways to protect these attacks so there is a need to learn how to combine the approaches to completely solve these problems. Proposed Framework is one such unique technique compose of two different defense mechanism. So by using blowfish algorithm, information security can be achieved to large extent.

As the research is going on, new features will be added that will only increase their security and speed.

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